Acknowledgements

The *2000 Code of Practice for Responsible Livestock Development and Manure Management* replaces the *1995 Code of Practice for the Safe and Economic Handling of Animal Manures*. In this document, the *2000 Code of Practice for Responsible Livestock Development and Manure Management* will be referred to as the "Code". The Code provides technical guidelines for the siting of intensive livestock operations in Alberta.

The following groups are recognized for their input in the development of this document.

Alberta Agriculture, Food and Rural Development
Alberta Environment
Alberta Health and Wellness
Alberta Municipal Affairs
Westpeake Consulting Ltd.

The Code incorporates some of the recommendations proposed by the Livestock Regulations Stakeholder Advisory Group and its Standards Expert Committee.

For additional information on the Code and its use, contact the Alberta Agriculture, Food and Rural Development (AAFRD) Intensive Livestock Operations Engineers at:

Agriculture Centre
5401 - 1st Avenue South
Lethbridge, AB T1J 4V6
Phone: (403) 381-5131
Fax: (403) 381-5806

Provincial Building
Rm. 301, 4920 - 51 Street
Red Deer, AB T4N 6K8
Phone: (403) 340-5359
Fax: (403) 340-4896

Second Floor, Provincial Building
6203 - 49 Street
Barrhead, AB T7N 1A4
Phone: (780) 674-8249
Fax: (780) 674-8309

Main Floor, Provincial Building
4809 - 50 Street
Vegreville, AB T9C 1R6
Phone: (780) 632-5400
Fax: (780) 632-5495

Second Floor, Provincial Building
10209 - 109 Street
Fairview, AB T0H 1L0
Phone: (780) 835-2291
Fax: (780) 835-3600

101-03675/

Published by:

Alberta Agriculture, Food and Rural Development
Information Packaging Centre
7000 - 113 Street, Edmonton, Alberta
Canada T6H 5T6

Copyright © 2000. All rights reserved by her Majesty the Queen in the right of Alberta.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise without written permission from the Publishing Branch, Alberta Agriculture, Food and Rural Development.

ISBN 0-7732-6123-0

November 2000
Printed in Canada

Contents

Introduction 1

Section 1
Land Use Considerations 2

Section 2
Manure Storage 5

Section 3
Feedlots 13

Section 4
Runoff Control - Catch Basins 15

Section 5
Location and Management of Seasonal Feeding Sites 18

Section 6
Use of Animal Manures 19

Section 7
Compliance With Existing Legislation 24

Section 8
Definitions 27

Appendices 33

Introduction

Purpose

The purpose of the Code is to provide guidelines for the siting of new and expanding intensive livestock operations with the intent of:

- Providing responsible manure management guidelines.
- Protecting groundwater, surface water, and soil resources.
- Minimizing the nuisance effects of intensive livestock operations.
- Providing livestock operators with guidelines to minimize environmental and social impacts
- Providing livestock operators and municipal officials with a reference for conflict resolution.
- Providing municipal agencies with guidelines for land use bylaws and policies.
- Providing public confidence.

The siting and manure management elements in the Code provide flexibility in designing and operating manure management systems, including the use of alternative handling methods not specifically listed in this document.

This document does not specifically define generally acceptable practice referred to in the *Agricultural Operation Practices Act*.

The Intended User

The Code is intended for livestock operators, municipal officials, land use planners, and others concerned with siting new or expanding intensive livestock operations.

This document provides a guideline for Alberta Agriculture, Food and Rural Development (AAFRD) staff to evaluate and provide information for intensive livestock operations. This document also provides the municipal officials with recommended guidelines on which to evaluate intensive livestock operations applying for a development permit.

Section 1

Land Use Considerations

Expected Results

- Minimize the nuisance effects of intensive livestock operations.
- Reduced social and environmental impacts through appropriate site selection.
- Consistent application of the Minimum Distance Separation (MDS) method.

An appropriate site selection can reduce environmental risks as well as development and operating costs. The following preliminary information must be obtained when considering a site for an intensive livestock operation.

1.1 Siting to Reduce Odour Nuisance - Minimum Distance Separation (MDS) Method

Separation between intensive livestock operations and neighbours can compensate for normal odour production, thereby reducing potential nuisance conflicts. The MDS method is based on Livestock Siting Units (LSUs) which considers site specific factors such as livestock type, amount and type of manure production, and the manure handling system. Technological advancements in manure handling, storage, barn design and management can reduce nuisance potential, which may allow for a variance to the MDS requirement.

1.1.1 Application of MDS

The MDS method is a tool to reduce the potential for land use conflicts and minimize nuisance impacts on neighbours.

1.1.1.1 Application of the MDS Method for Agricultural Developments

The MDS method provides a recommended minimum distance separation between a new intensive livestock development or the expansion of an existing intensive livestock operation and neighbouring land uses (residential, commercial, or recreational).

1.1.1.2 Application of the MDS Method for the First Expansion of the Operation

Expansions that occur within a 3-year period of the issuance of a development permit shall be considered as a new development. No expansion factor will be applied. Expansions that occur after a 3-year period of the issuance of a development permit may have an expansion factor applied to the MDS. This is only applicable to the first expansion of the development. In such cases, the expansion factor (**Appendix C-2**) is applied.

1.1.2 Determining MDS

Measure the distance from the neighbouring adjoining residence (not property line) to the point closest to the developing livestock facility or manure storage facility. For the purpose of determining MDS, only the livestock and manure storage facilities are considered. Facilities associated with the intensive livestock operation, such as feed handling and storage, office, water supply, land on which manure is spread, and grazing areas are not considered to be part of the livestock facility for the purpose of determining the MDS. The MDS for various livestock types has been precalculated into tabular form to simplify their use (**Appendix D**). In no case shall the MDS be less than 150 metres (492 feet).

1.1.3 Operations on Separate Land Parcels

Intensive livestock operations on adjacent parcels of land under the same operator may be considered as one operation for the purpose of determining MDS, regardless of whether the operations are on one or more land titles

1.1.4 Exemptions to MDS

Residences owned or under the control of the intensive livestock operator are considered exempt from the MDS siting requirements of the intensive livestock operation. Part of the MDS requirement for an expanding intensive livestock operation may be waived if existing neighbouring land uses are in agreement.

1.1.5 Variance to MDS

All possible ways of reducing nuisance associated with the livestock facility design, such as siting, topography, climate, and manure management cannot be included in the MDS tables. Management techniques or technology that clearly alters nuisance could affect the MDS. Variance to the MDS may be permitted upon consultation with Alberta Agriculture, Food and Rural Development staff. The affected party must provide documented justification for any variances which are applied for. Factors that may affect variances are:

1.1.5.1 Unique Topography

Topographical features can alter the effect of odour movement and dispersion.

1.1.5.2 Physical and Visual Screening

Natural or constructed screening can improve the aesthetics of the livestock facility or manure storage facility. Screening can assist in minimizing odours by reducing wind effects at the manure storage facility.

1.1.5.3 Micro-Climate

Available meteorological data may demonstrate significant alteration in odour intensity or frequency of occurrence in relation to a neighbouring land use. Some of these parameters include temperature, humidity, and wind direction and velocity.

1.1.5.4 Management/Technology

The use of management or technology capable of altering nuisance may be used to alter the MDS requirement.

1.2 Environmental Siting Considerations

Soil, topographic, and hydrologic conditions must be considered in siting the facilities of intensive livestock operations to prevent the movement of manure nutrients into groundwater and surface water. These conditions determine risk to the environment and should be assessed prior to construction.

1.2.1 Engineering Soil Investigation

To ensure the protection of groundwater and surface water, a soils investigation is recommended for facilities where manure or manure runoff is stored. Parameters pertinent to the subsoil investigation include depth to bedrock, depth to groundwater, soil permeability, soil texture, and soil plasticity.

1.2.1.1 Identify Depth to Bedrock

Identify depth to bedrock from the bottom elevation of the manure storage facility.

1.2.1.2 Soil Plasticity

Soil plasticity index should be measured.

1.2.1.3 Soil Texture

Particle size analysis (percentage of sand, silt, clay, gravel) is an acceptable indication of soil texture.

1.2.1.4 Permeability of Site

Sites with fine textured (low to very low permeability) soils are more suitable. Soil texture and plasticity will indicate permeability. Site specific tests may be required to determine permeability.

1.2.2 Depth to Water Table

Determine depth to the seasonal high water table and annual water table variations. The bottom elevation of the manure storage facility must be constructed a minimum of 1 metre (3.28 feet) above the seasonal high water table.

1.2.3 Water Source and Supply

Identify groundwater and surface water sources, as well as quantity and quality. Determine if artesian and/or perched groundwater exists at the site.

1.2.4 Water License

Withdrawal of groundwater and surface water is legislated under the *Water Act*. Contact Alberta Environment for the necessary approvals. If irrigation water is to be used for the livestock facility, the nearest Irrigation District Office must also be contacted. If water is to be used for the livestock facility through a water co-op, then the local water co-op must be contacted.

Section 2

Manure Storage

Expected Results

- Protection of groundwater and surface water.
- Minimize nuisance effects.
- Conservation of manure nutrients.

All manure must be stored in proper storage facilities as defined within this section.

2.1 Solid Manure - Long-term Manure Storage

Manure storage facilities must be designed and located to minimize odour nuisance and protect groundwater and surface water.

2.1.1 Manure Production Volumes

Storage volumes for most common livestock types have been precalculated in tabular form in **Appendix B-1** for solid manure production. These volumes are based on common intensive livestock management systems. Actual volumes may vary depending on production and manure management, and facility design factors.

2.1.2 Storage Volume

A minimum of 9 months of storage volume must be provided to store all of the manure, wash water, and water spillage produced by the intensive livestock operation.

2.1.3 Design and Construction Verification

It is recommended that intensive livestock operators verify, through a Professional Engineer, that the solid manure storage facility was designed and constructed to meet the standards provided in this document.

2.1.4 Protection of Groundwater and Surface Water

2.1.4.1 New Manure Storage Facilities

New manure storage facilities must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.1.4.2 Existing Manure Storage Facilities

2.1.4.2.1 Existing manure storage facilities that are expanded must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.1.4.2.2 Section 2.1.4.2.1(i) does not apply if the operator can demonstrate that the aquifers, through which the water well has been drilled, have not been adversely impacted by the operation, implements a groundwater monitoring program, and maintains annual monitoring results.

2.1.4.2.3 Section 2.1.4.2.1(ii) does not apply if it can be demonstrated that the natural drainage is away from the open body of water and secondary protection, such as a berm, is provided.

2.1.5 Flood Prevention

Newly constructed and existing expanded manure storage facilities, constructed near an open body of water, must:

(i) be a minimum of 1 metre (3.28 feet) in elevation above the 1:50 year floodplain or, if not known, 1 metre (3.28 feet) in elevation above the highest known flood level, and

(ii) have erosion control measures that are adequate to withstand a 1:50 year flood.

2.1.6 Depth to Water Table

The bottom elevation of the manure storage facility must be constructed a minimum of 1 metre (3.28 feet) above the seasonal high water table.

2.1.7 Surface Water Runoff Control Systems

Runoff from a solid manure storage facility must not enter an open body of water or leave the owner's property.

2.1.8 Surface Water Run-on Control Systems

There must be a run-on control system that prevents the flow of surface water into the manure storage facility.

2.1.9 Liner Systems

Long-term solid manure storages must be constructed with:

(i) a minimum of 2 metres (6.56 feet) of natural material, at a hydraulic conductivity of no greater than 1 x 10^{-6}cm/sec, between the bottom of the storage and the uppermost identified groundwater source, or

(ii) a material that provides an equivalent or greater protection than (i), with the design and construction verified by a Professional Engineer.

2.1.10 Concrete or Alternative Manure Storage

A concrete or alternative manure storage facility may be required on porous soil and/or fractured bedrock that would allow contaminants direct access to groundwater.

2.2 Solid Manure - Short-term Manure Storage

Short-term storage of solid manure is only permitted for a period not exceeding 6 continuous months in a given location over a 3-year period. For the purpose of this Code, active feedlots and livestock corrals are not considered short-term manure storage facilities.

2.2.1 Manure Production Volumes

Storage volumes for most common livestock types have been precalculated in tabular form in **Appendix B-1** for solid manure production. These volumes are based on common intensive livestock management systems. Actual volumes may vary depending on production and manure management, and livestock facility design factors.

2.2.2 Protection of Groundwater and Surface Water

Short-term manure storage must be located to protect groundwater and surface water. Short-term manure storages must not be located within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.2.3 Depth to Water Table

The bottom elevation of the short-term manure storage facility must be located a minimum of 1 metre (3.28 feet) above the seasonal high water table.

2.2.4 Surface Water Runoff Control Systems

Runoff from a short-term manure storage facility must not enter an open body of water or leave the owner's property.

2.2.5 Surface Water Run-on Control Systems

There must be a run-on control system that prevents the flow of surface water into the short-term manure storage.

2.2.6 Proximity to Neighbours

Locate short-term manure storage to minimize nuisance to neighbours. The MDS method indicated in **Section 1** does not apply to short-term manure storage.

2.3 Solid Manure - Composting

Composting should be conducted in compliance with *Alberta Environment Code of Practice for Compost Facilities* under their *Waste Control Regulation A.R. 192/96.*

2.4 Liquid Manure - Earthen Manure Storage

Liquid earthen manure storage facilities must be designed and constructed to minimize odour nuisance and protect groundwater and surface water.

2.4.1 Safety Considerations of Liquid Manure Handling

Note: Operators and their employees must take extreme care when working near liquid earthen manure storage facilities. Caution is advised, especially when agitating and removing liquid manure from any storage, as manure gases can accumulate and may be fatal. Hydrogen sulfide is a common lethal gas generated by liquid manure. At lethal levels, you are not able to smell hydrogen sulfide.

2.4.1.1 Fencing

All open liquid earthen manure storages must be secured to prevent unauthorized access.

2.4.1.2 Posting of Storage Facility

Liquid earthen manure storage facilities must be designated with appropriate warning signs.

2.4.1.3 Access

An all-weather road to the liquid earthen manure storage facility must be provided.

2.4.2 Design and Construction

The integrity of a liquid earthen manure storage must be assured by conducting an appropriate engineering soils investigation of the site or through the evidence of impermeability of an existing storage.

Intensive livestock operators must verify, through a Professional Engineer, that the liquid earthen manure storage facility was designed and constructed to meet the standards provided in this document.

2.4.3 Filling Liquid Earthen Manure Storages

It is recommended that liquid earthen manure storages be bottom loaded.

2.4.4 Side Slopes

Stability of the material and method of emptying will determine side slopes, which in any case, will be no steeper than 1.5:1.

2.4.5 Manure Storage Volumes

A minimum of 9 months of storage volume must be provided to store all of the manure, wash water, and water spillage produced by the operation.

2.4.6 Manure Production Volumes

Storage volumes for most common livestock types have been precalculated in tabular form in **Appendix B-2** for liquid manure production. These volumes are based on common intensive livestock management systems. Actual volumes may vary depending on production and manure management, and livestock facility design factors.

2.4.7 Freeboard for Liquid Earthen Manure Storages

A 0.5 metres (20 inches) freeboard must be provided.

2.4.8 Erosion Control

The liquid earthen manure storage facility must have adequate erosion control measures.

2.4.9 Protection of Groundwater and Surface Water

2.4.9.1 New Liquid Earthen Manure Storage Facilities

New liquid earthen manure storage facilities must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.4.9.2 Existing Liquid Earthen Manure Storage Facilities

2.4.9.2.1 Existing liquid earthen manure storage facilities that are expanded must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.4.9.2.2 Section 2.4.9.2.1(i) does not apply if the operator can demonstrate that the aquifers, through which the water well has been drilled, have not been adversely impacted by the operation, implements a groundwater monitoring program, and maintains annual monitoring results.

2.4.9.2.3 Section 2.4.9.2.1(ii) does not apply if it can be demonstrated that the natural drainage is away from the open body of water and secondary protection, such as a berm, is provided.

2.4.10 Flood Prevention

Newly constructed and existing expanded liquid earthen manure storage facilities, constructed near an open body of water must:

(i) be a minimum of 1 metre (3.28 feet) in elevation above the 1:50 year floodplain or, if not known, 1 metre (3.28 feet) in elevation above the highest known flood level, and

(ii) have erosion control measures that are adequate to withstand a 1:50 year flood.

2.4.11 Depth to Water Table

The bottom elevation of the liquid earthen manure storage facility must be constructed a minimum of 1 metre (3.28 feet) above the seasonal high water table.

2.4.12 Surface Water Runoff Control Systems

Runoff from the liquid earthen manure storage facility must not enter an open body of water or leave the owner's property.

2.4.13 Surface Water Run-on Control Systems

There must be a run-on control system that prevents the flow of surface water into the liquid earthen manure storage facility.

2.4.14 Liner Systems

Liquid earthen manure storage facilities must be constructed with:

(i) a minimum of 10 metres (32.8 feet) of natural uniform material, at a hydraulic conductivity no greater than 1 x 10^{-6} cm/sec, between the bottom and sides of the storage, and above the uppermost identified groundwater source, or

(ii) a material that provides an equivalent or greater protection than (i), with the design and construction verified by a Professional Engineer.

2.4.15 Secondary Containment

Where catastrophic failure could result in direct discharge into an open body of water or leave the owner's property, secondary containment of the liquid earthen manure storage facility's contents may be required.

2.4.16 Seepage Monitoring

Seepage monitoring may be required for liquid earthen manure storages.

2.5 Liquid Manure - Concrete and Steel Storage

Liquid manure storage facilities must be designed and located to minimize odour nuisance and protect groundwater and surface water.

2.5.1 Safety Considerations of Liquid Manure Handling

Note: Operators and their employees must take extreme care when working near liquid manure storage facilities. Caution is advised, especially when agitating and removing liquid manure from any storage, as manure gases can accumulate and may be fatal. Hydrogen sulfide is a common lethal gas generated by liquid manure. At lethal levels, you are not able to smell hydrogen sulfide.

2.5.1.1 Fencing

All open liquid manure storage facilities must be secured to prevent unauthorized access.

2.5.1.2 Posting of Storage Facility

Liquid manure storage facilities must be designated with appropriate warning signs.

2.5.1.3 Access

An all-weather road to the liquid manure storage facility must be provided.

2.5.2 Design and Construction Verification

Intensive livestock operators must verify, through a Professional Engineer, that the concrete and steel storage facilities are properly designed and constructed.

2.5.3 Filling Liquid Manure Storages

It is recommended that liquid manure storages be bottom loaded.

2.5.4 Liquid Manure Storage Volumes

A minimum of 9 months of storage volume must be provided to store all of the manure, wash water, and water spillage produced by the operation.

2.5.5 Liquid Manure Production Volumes

Storage volumes for most common livestock types have been precalculated in tabular form in **Appendix B-2** for liquid manure production. These volumes are based on common intensive livestock management systems. Actual volumes may vary depending on production and manure management, and livestock facility design factors.

2.5.6 Protection of Groundwater and Surface Water

2.5.6.1 New Liquid Manure Storage Facilities

New liquid manure storage facilities must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.5.6.2 Existing Liquid Manure Storage Facilities

2.5.6.2.1 Existing liquid manure storage facilities that are expanded must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

2.5.6.2.2 Section 2.5.6.2.1(i) does not apply if the operator can demonstrate that the aquifers, through which the water well has been drilled, have not been adversely impacted by the operation, implements a groundwater monitoring program, and maintains annual monitoring results.

2.5.6.2.3 Section 2.5.6.2.1(ii) does not apply if it can be demonstrated that the natural drainage is away from the open body of water and secondary protection, such as a berm, is provided.

2.5.7 Flood Prevention

Newly constructed and existing expanded liquid manure storage facilities, constructed near an open body of water must:

(i) be a minimum of 1 metre (3.28 feet) in elevation above the 1:50 year floodplain or, if not known, 1 metre (3.28 feet) in elevation above the highest known flood level, and

(ii) have erosion control measures that are adequate to withstand a 1:50 year flood.

2.5.8 Depth to Water Table

The bottom elevation of the liquid manure storage facility must be constructed a minimum of 1 metre (3.28 feet) above the seasonal high water table.

2.5.9 Surface Water Runoff Control Systems

Runoff from the liquid manure storage facility must not enter an open body of water or leave the owner's property.

2.5.10 Surface Water Run-on Control Systems

There must be a run-on control system that prevents the flow of surface water into the liquid manure storage facility.

2.5.11 Secondary Containment

Where catastrophic failure could result in direct discharge into an open body of water or leave the owner's property, secondary containment of the liquid manure storage contents may be required.

2.6 Liquid Manure - Alternative Liner Systems

Alternative liner systems may be considered . Refer to **Liquid Earthen Manure Storage - Liner Systems: Section 2.4.14(ii)**. Alternative liner systems must be verified by a Professional Engineer.

2.6.1 Seepage Monitoring

Seepage monitoring may be required for liquid manure storage facilities.

2.7 Evolving Technologies

Alternative methods of manure application or management systems that can be shown to effectively retain nutrients on the land, reduce odour production, and protect groundwater and surface water may be taken into consideration.

Section 3

Feedlots

Soil, topographic and hydrologic conditions must be considered in the siting of an open feeding facility to prevent the movement of manure nutrients into groundwater and surface water.

3.1 Design and Construction Verification

It is recommended that intensive livestock operations verify, through a Professional Engineer, that the feedlot facility was designed to meet the standards provided in this document.

3.2 Protection of Groundwater and Surface Water

3.2.1 New Feedlot Facilities

New feedlot facilities shall not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

3.2.2 Existing Feedlot Facilities

3.2.2.1 Existing feedlot facilities that are expanded must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

3.2.2.2 Section 3.2.2.1(i) does not apply if the operator can demonstrate that the aquifers, through which the water well has been drilled, have not been adversely impacted by the operation, implements a groundwater monitoring program, and maintains annual monitoring results.

3.2.2.3 Section 3.2.2.1(ii) does not apply if it can be demonstrated that the natural drainage is away from the open body of water and secondary protection, such as a berm, is provided.

3.3 Flood Prevention

Newly constructed and existing expanded feedlot facilities, constructed near an open body of water must:

(i) be a minimum of 1 metre (3.28 feet) in elevation above the 1:50 year floodplain or, if not known, 1 metre (3.28 feet) in elevation above the highest known flood level, and

(ii) have erosion control measures that are adequate to withstand a 1:50 year flood.

3.4 Depth to Water Table

The bottom elevation of the feedlot pens must be constructed a minimum of 1 metre (3.28 feet) above the seasonal high water table.

3.5 Surface Water Runoff Control Systems

Drainage must be provided within the feedlot and animal holding areas to prevent the retention of surface water and manure runoff. Manure runoff from the drainage system must not enter an open body of water or leave the owner's property. Drainage must be directed to a catch basin or handled using an acceptable alternative method.

3.6 Surface Water Run-on Control Systems

Surface run-on water originating outside the feedlot facility should be diverted around the facility.

3.7 Non-operational Feedlots

Unused feedlot pens must be completely cleaned of manure within 1 year of abandonment.

3.8 Pen Cleaning

Avoid over-cleaning of the feedlot pen surface that would disturb the compacted gleyed layer.

3.9 Permeability of Feedlot Site

Avoid sites with soils and/or fractured bedrock that would allow contaminants direct access to groundwater. Feedlot facilities must be constructed on:

(i) a minimum of 2 metres (6.56 feet) of natural material, at a hydraulic conductivity of no greater than 1×10^{-6} cm/sec, between the bottom of the pens and the uppermost identified groundwater source, or

(ii) a material that provides an equivalent or greater protection than (i), and verified by a Professional Engineer.

Section 4

Runoff Control - Catch Basins

Expected Results

- Protection of groundwater and surface water.
- Minimize nuisance effects.

4.1 Safety Considerations

Note: Operators and their employees must take extreme care when working near liquid manure storage facilities. Caution is advised especially when agitating and removing liquid manure from any storage as manure gases can accumulate and may be fatal. Hydrogen sulfide is a common lethal gas generated by liquid manure. At lethal levels, you are not able to smell hydrogen sulfide.

4.1.1 Fencing

All open runoff control catch basins must be secured to prevent unauthorized access.

4.1.2 Posting of Runoff Control Catch Basins

Runoff control catch basins should be designated with appropriate warning signs.

4.1.3 Access

An all-weather access road to the catch basin must be provided.

4.2 Design and Construction

The integrity of a catch basin must be assured by conducting an appropriate engineering soils investigation of the site or through the evidence of impermeability of an existing catch basin. Intensive livestock operators must verify, through a Professional Engineer, that the catch basin was designed and constructed to meet the standards provided in this document.

4.3 Side Slopes

Stability of the material and method of emptying will determine side slopes, which in any case will be no steeper than 1.5:1.

4.4 Catch Basin Storage Volume

Catch basin storage volume must be designed and operated to accommodate runoff from a 1 in 30 year, 24 hour precipitation event. Refer to **Appendix F**.

4.5 Freeboard

A 0.5 metres (20 inches) of freeboard must be provided.

4.6 Protection of Groundwater and Surface Water

4.6.1 New Catch Basins

New catch basins must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

4.6.2 Existing Catch Basins

4.6.2.1 Existing catch basins that are expanded must not be constructed within:

(i) 100 metres (328 feet) of any spring or water well, and

(ii) 30 metres (98.4 feet) of any open body of water.

4.6.2.2 Section 4.6.2.1(i) does not apply if the operator can demonstrate that the aquifers, through which the water well has been drilled, have not been adversely impacted by the operation, implements a groundwater monitoring program, and maintains annual monitoring results.

4.6.2.3 Section 4.6.2.1(ii) does not apply if it can be demonstrated that the natural drainage is away from the open body of water and secondary protection, such as a berm, is provided.

4.7 Flood Prevention

Newly constructed and existing expanded catch basins, constructed near an open body of water must:

(i) be a minimum of 1 metre (3.28 feet) in elevation above the 1:50 year floodplain or, if not known, 1 metre (3.28 feet) in elevation above the highest known flood level, and

(ii) have erosion control measures that are adequate to withstand a 1:50 year flood.

4.8 Depth to Water Table

The bottom elevation of the catch basin must be constructed a minimum of 1 metre (3.28 feet) above the seasonal high water table.

4.9 Surface Water Run-on Control Systems

Surface run-on water originating outside the catch basin design area must be diverted around the area.

4.10 Utilization of Catch Basin Contents

Runoff catch basin contents must be managed and handled so that it does not contaminate groundwater and surface water. Runoff catch basin contents must be utilized to ensure adequate storage volume is maintained for additional runoff events. Refer to **Section 6 - Use of Animal Manure**.

4.11 Liner Systems

4.11.1 For each catch basin that holds runoff for less than 60 days, the catch basin must be constructed with:

(i) a minimum of 2.5 metres (8.2 feet) of natural uniform material, at a hydraulic conductivity of no greater than 1×10^{-6} cm/sec, between the bottom and sides of the catch basin and the uppermost identified groundwater source, or

(ii) a material that provides an equivalent or greater protection than (i), with the design and construction verified by a Professional Engineer.

4.11.2 For catch basins that hold runoff for greater than 60 days, the catch basin must be constructed with:

(i) a minimum of 5 metres (16.4 feet) of uniform natural material, at a hydraulic conductivity of no greater than 1×10^{-6} cm/sec, between the bottom and sides of the catch basin and the uppermost identified groundwater source, or

(ii) a material that provides the equivalent or greater protection than (i), with the design and construction verified by a Professional Engineer.

4.12 Alternative Runoff Control

Alternative methods of manure runoff control that can be shown to effectively protect surface water and groundwater and minimize odour nuisances, may be considered

Section 5

Location and Management of Seasonal Feeding Sites

Expected Results

- Protection of groundwater and surface water.
- Minimize nuisance effects.
- Conservation of manure nutrients.
- Protection of riparian areas.

The risk of contamination to groundwater and surface water from feeding sites must be minimized through proper siting and runoff management.

5.1 Surface Water Run-on Control Systems

Prevent uncontaminated rainfall and snowmelt run-on from entering the feeding site.

5.2 Manure Accumulation

Feeding sites must be managed to protect groundwater and surface water from manure contamination. Accumulated manure must be utilized (refer to **Section 6 - Use of Animal Manure**) or stored (refer to **Section 2 - Manure Storage**).

5.3 Rivers, Creeks, and Riparian Areas

Protect rivers, creeks, and riparian areas from becoming contaminated by manure.

5.4 Alternative Runoff Control

Under site specific conditions, alternatives to controlling runoff, such as vegetative buffers, may be considered to mitigate surface water impacts from runoff.

Section 6

Use of Animal Manure

Expected Results

- Maximize manure nutrient retention.
- Increased soil productivity or quality from manure application.
- Manure application is based on crop production needs.
- Protect soil, water, and air quality.
- Minimize odour nuisance.

When applied in appropriate locations, at rates that are in balance with crop uptake, manure poses a minimal risk to the environment. Manure utilization through land application must consider meteorological, topographical, and soil conditions together with the application time and rate to avoid groundwater or surface water contamination. Crop nutrients from all sources must be managed, including commercial fertilizers, food processing and municipal waste products, manure and residual soil nutrients.

Odour nuisance, associated with the spreading of manure on land, can be minimized through proper timing, siting, method of incorporation, and frequency of application.

For all new and expanding intensive livestock operations, a nutrient management plan is strongly recommended. The plan would include balancing long-term nutrient application rates with crop nutrient uptake while assessing the potential risk of nutrients entering water sources.

6.1 Record Keeping

As a minimum, records of the following information must be kept by those in control of land where manure is to be applied:

(a) the date when manure from the operation was applied;

(b) the volume (or weight) of manure applied to each field;

(c) the legal land location of each field;

(d) the size of the field (acres/hectares);

(e) results of soil sampling of the land prior to applying the manure as detailed in **Section 6.2**;

(f) estimate of N, P, K and S of the manure applied;

(g) the persons to whom they transferred or sold their manure, the date of the transfer or sale, and the amount transferred or sold.

6.2 Nutrient Analysis

A nutrient analysis allows for a better understanding of how much nutrient is in the soil as well as how much nutrient is being applied in order to balance the manure application with crop uptake.

6.2.1 Soil Analysis

Standard laboratory procedures must be used for the soil analysis and this information should be reflected in the records kept. Soil sampling must occur before nutrient application. The following results must be obtained:

(a) extractable nitrate nitrogen (NO_3-N) and extractable ammonium (NH_4-N) from a soil depth of 0 - 60 cm (0 - 24 in.);

(b) extractable phosphate phosphorus (PO_4-P) using the Modified Kelowna method from a soil depth of 0 - 15 cm (0 - 6 in.);

(c) soil salinity based on Electrical Conductivity (E.C.) of a saturated paste extract;

(d) soil potassium and sulfur;

(e) soil texture: one time analysis.

6.2.2 Nutrient Content of Manure

Since manure nutrient content is highly variable, a representative analysis (NH_4-N, NO_3-N, Total N, Total P, K and S) of the manure source should be obtained for more accurate data. When a manure analysis is not available, the nutrient content of typical stored manure found in **Appendix A** can be used as a general guide. However, **Appendix A** should not be relied on in place of an actual analysis.

6.3 Manure Application Limits

The process of recycling nutrients from livestock manure through crop production is complex and affected by many variables, such as soil, climate, feed ration, cropping system, and time. A long-term nutrient management plan should be in place to ensure that (i) all manure nutrients produced are recycled and (ii) runoff risk to surface water or leaching to groundwater is minimized.

6.3.1 Salinity

On the basis of a representative soil analysis of 0 to 15 centimetres (0 to 6 inches), the following levels in any part of the field would result in potential risk to soil productivity and quality in those parts of the field if manure is continuously applied

Soil salinity is measured by the Electrical Conductivity (E.C.) of a saturated paste extract. Manure application must not result in an increase in the soil E.C. of more than 1 deciSeimens/metre (dS/m) in any part of the field.

6.3.2 Balancing Manure Application with Crop Needs and Runoff Risk

Nutrients should only be applied to meet crop requirements. However, if properly managed, a single manure application to meet crop requirements over a longer term may be used. The following application rates (**Section 6.3.2.1(i)**) are presented as a guide for cases where nutrient management planning is not yet developed. All rates presented are based on fall soil sampling and analysis.

6.3.2.1 Nitrogen (N)

Water and air quality may be degraded if nitrogen rates are in excess of crop uptake.

(i) Manure application must not occur when Nitrate-Nitrogen (NO_3-N) levels in the top 60 cm (24 inches) of the soil profile have exceeded the following levels, or

Soil	Sandy (> 45% Sand) and water table < 4m	Sandy (> 45% Sand) and water table > 4m	Medium and Fine Textured Soils
Brown	80 kg/ha (75 lb/ac)	110 kg/ha (100 lb/ac)	140 kg/ha (125 lb/ac)
Dark Brown	110 kg/ha (100 lb/ac)	140 kg/ha (125 lb/ac)	170 kg/ha (150 lb/ac)
Black	140 kg/ha (125 lb/ac)	170 kg/ha (150 lb/ac)	225 kg/ha (200 lb/ac)
Luvisolic (Grey Wooded)	110 kg/ha (100 lb/ac)	140 kg/ha (125 lb/ac)	170 kg/ha (150 lb/ac)
Irrigated	225 kg/ha (200 lb/ac)	280 kg/ha (250 lb/ac)	335 kg/ha (300 lb/ac)

(ii) the application limits set in Section 6.3.2.1(i) may be altered through the development of a nutrient management plan.

6.3.2.2 Phosphorus (P)

Once P has accumulated in high concentrations in the soil, it can take several years for crop use to reduce P levels. High P levels in the soil can result in a potentially higher risk for runoff contamination. In some situations, phosphorus may be considered a more limiting nutrient than nitrogen over time. Therefore, manure application adjustments may be required to address soil phosphorus levels.

6.3.3 Land For Manure Application

Applying manure based on crop Nitrogen requirements can lead to elevated levels of Phosphorus in the soil. Over time, any single nutrient which is overabundant may limit future manure application rates. Therefore, long-term nutrient management planning is recommended.

For the purpose of this Code, land base requirements for manure application are based on nitrogen requirements.

(i) New or expanding livestock operations may use **Appendix E** (nitrogen based method) to determine their land base requirements during the environmental screening stage of planning as long as the limits set out in **Section 6.3.2.1(i)** are observed, or

(ii) the land base values in **Appendix E** may be altered through the development of a nutrient management plan.

6.3.4 Control of Land Base

Land suitable for utilizing available manure nutrients can either be owned by the livestock operator or accessed through arrangements with other land owners.

6.4 Method of Application

The goal sought when applying livestock manure as a fertilizer should be to maximize the utilization of the manure nutrients by crops and *minimize the risk of degrading both water and air quality.*

6.4.1 Assessing Runoff Risk

Site specific risk factors need to be identified and assessed to minimize the transport of manure constituents into an open body of water or groundwater. Such factors include:

- topographical features such as slope, distance to surface water, depth to water table, etc.;
- critical nutrient source factors, including soil nitrogen and phosphorus levels;
- climatic data;
- cropping and fertilizing history.

6.4.2 Location of Manure Application on Cropland

The application of manure must not occur within:

(a) 10 metres (32.8 feet) of an open body of water using subsurface injection equipment;

(b) 10 metres (32.8 feet) of an open body of water, if surface-applied and incorporated within the same working day;

(c) 30 metres (98.4 feet) of an open body of water, if surface-applied and incorporated within 48 hours;

(d) 30 metres (98.4 feet) of a water well, whether surface-applied or subsurface injected.

6.4.3 Land Subject To Runoff

Unless incorporated within 24 hours, manure must not be spread on land where the hydrological characteristics are such that a storm or snowmelt event would result in:

(a) direct movement of surface runoff into an open body of water;

(b) surface runoff leaving the property controlled by the operator (crossing a property line).

6.4.4 Incorporation of Manure Into Land

Manure should be incorporated into the soil within 48 hours of application, subject to **Section 6.5 Exceptions to Incorporation**.

6.4.5 Acceptable Methods of Incorporation

Tillage, plough-down, and direct injection into the soil are considered acceptable methods of incorporation; however, other alternative methods of incorporation may be considered.

6.4.6 Consideration of Neighbours

Apply manure to land when it is least likely to cause odour impacts to neighbouring residents. Use methods of incorporation appropriate to the odour sensitivity of the site.

6.4.7 Weather Conditions

Wind and weather conditions can greatly help or hinder odour nuisance and nutrient loss when applying manure to land. Spread manure when favourable weather conditions are predicted. Odour problems are increased under calm conditions with high humidity.

6.4.8 Spreading Manure on Frozen Ground

Manure must not be applied on frozen or snow covered soil, unless the person responsible for the land where the manure will be spread can demonstrate that the application will not adversely impact groundwater and surface water, or create a significant odour nuisance.

6.5 Exceptions to Incorporation

Surface application of manure at rates set out in **Section 6.3** without incorporation within 48 hours is only acceptable in the following situations:

6.5.1 Forage Crops and Direct-Seeded Land

Forage and direct-seeded lands that are not considered to be a moderate or high runoff risk to an open body of water or a nuisance conflict, and meet the conditions set out in **Section 6.3**.

Surface application of manure on forage crops or direct-seeded land without incorporation is only acceptable if the following minimum setback distances are met:

(a) for land having a mean slope of less that 4%, 30 metres (98.4 feet) from any open body of water;

(b) for land having a mean slope of 4% but less than 6%, 60 metres (196.8 feet) from any open body of water;

(c) for land having a mean slope of 6% but less than 12%, 90 metres (295.3 feet) from any open body of water;

(d) manure should not be applied on land having a mean slope of 12% or greater near an open body of water.

6.5.2 Irrigation Water

Liquid manure or runoff catch basin water:

(i) can only be applied with irrigation water if it can be demonstrated not to cause an undue odour problem;

(ii) can only be applied to land subject to flood irrigation under supervision or approval of the appropriate irrigation or soil conservation authority to ensure that no water leaves the property, enters an open body of water, or becomes return flow;

(iii) must not be applied with irrigation water on crops that are to be eaten uncooked;

(iv) can only be applied with irrigation water if proper backflow prevention equipment is installed.

6.5.3 Evolving Technologies

An alternative method of manure application or management system that can be demonstrated to effectively retain nutrients on the land and minimize odour may be considered by the permitting authority.

6.5.4 Composted Manure

Composted manure can be applied to land based on the requirements set out in **Section 6.3** and **6.4**.

Section 7

Compliance With Existing Legislation

This Code is intended as a guide to readers to provide assistance on the matters covered in it. It is not an exhaustive review of applicable legislation. Readers are responsible for ensuring that they comply with all legislation in Alberta governing their activities.

There are several acts and regulations that apply to livestock operations. It is important to remember that the *Public Health Act* will apply to any individual practice, law, license, approval, permit or other authorization issued by either the provincial or municipal government. As well, general provisions of the *Environmental Protection and Enhancement Act*, *Water Act*, *Regulations Regarding the Destruction and Disposal of Dead Animals Act* and the *Fisheries Act* apply to livestock operations.

Current Provincial Legislation

7.1 Public Health Act

The *Public Health Act* takes precedence over all other provincial statutes except the *Alberta Bill of Rights*. Under public health or nuisance provisions, the Regional Health Authority can take any action needed, in its opinion, to order the elimination of a health risk. The Act is enforced by the province's 17 Regional Health Authorities.

7.2 Environmental Protection and Enhancement Act

Alberta farmers, as with all Albertans, are subject to general environmental protection laws. No person is allowed to release into the environment any substance, in any amount, that causes or may cause a significant adverse effect. Adverse effect means impairment of, or damage to, the environment, human health, safety, or property. Alberta Environment is responsible for enforcing this legislation.

7.2.1 Land and Water

As manure releases are not required to be authorized, the operator is able to store and handle the manure as long as it does not cause a significant adverse effect. Transported manure must be adequately contained or covered to prevent it from falling off or being blown off of vehicles and equipment on public roads. Alberta Environment is responsible for enforcement, with some delegation to municipalities for litter provisions. The Act has been used to resolve and enforce point-source pollution releases from livestock operations.

7.2.2 Air

Releases of gases from fresh manure or manure that is stored and handled do not require approvals. However, burning of animal manure and dead animals by open fire is not permitted unless specifically approved by Alberta Environment.

7.3 Livestock Diseases Act

Under the *Regulations Regarding the Destruction and Disposal of Dead Animals*, dead animals must be properly disposed of within 48 hours to minimize odours, flies, and transmission of disease to other animals. Under specific conditions, animals can be either buried, burned, composted, naturally disposed of, or transported to a rendering plant for disposal. Although the legislation is under Alberta Agriculture, Food and Rural Development, appointed veterinary inspectors and peace officers may enforce provisions of the Act.

7.4 Agricultural Operation Practices Act

This Act is designed to protect farmers who are (1) using generally accepted practices, (2) following municipal bylaws, and (3) following any regulations under the Act from common law nuisance liability. Farms retain protection even if the municipal bylaws or adjacent land uses change. The Act allows the Minister of Alberta Agriculture, Food and Rural Development to make regulations concerning agricultural practices. Currently, there are no regulations.

7.5 Water Act

This Act balances policy interests such as management of water supply, environmental sustainability, and Alberta's economic growth and prosperity. The provincial water licensing procedure is designed to ensure that the operator has a sufficient and sustainable water source and that a new withdrawal will have no affect on those already drawing water from the same source. Once the operator has a license, he is protected from new developments that may adversely affect his current water needs. In times of shortage, water for human domestic needs takes precedent over any other use of water. In times of extreme water shortages, Alberta Environment will enforce the hierarchy of domestic use and water licenses.

7.6 Municipal Government Act

To achieve orderly, economical and beneficial development, use of land, patterns of human settlement, and quality of physical environment, Alberta's rural municipalities have been responsible for development control of intensive livestock operations since the 1950's. To develop their own laws regarding subdivision and development, the municipality writes a Municipal Development Plan (required by municipalities with a population of over 3,500) that describes future land uses within the municipality and the manner in which these uses will be reviewed. As well, all municipalities must adopt a Land Use Bylaw that divides the municipality into land use districts that establishes permitted and discretionary uses, describes decision-making processes and notification procedures. Both Municipal Development Plans and Land Use Bylaws require public hearings before they are adopted. Municipalities are responsible for enforcing bylaws and development conditions.

Municipal councils may pass bylaws respecting safety, health and welfare of people, including the protection of people and property. These bylaws may include nuisance, activities in relation to wild or domestic animals and transportation. Bylaws made in relation to these subjects may have an impact on agricultural operations.

7.7 Fisheries Act (Canada)

Manure escaping from a lagoon, runoff from fields where manure was recently spread, or improperly disposed dead animals may be considered a harmful substance if fish and fish habitat are threatened. The *Fisheries Act* has provisions for fines and imprisonment if harmful substances are deposited into water frequented by fish, including water that may eventually enter water frequented by fish.

Section 8

Definitions

Beef Feeders
Beef cattle raised for market in approximately the 204 - 408 kg (450 - 900 lb) weight range.

Beef Finishers
Beef cattle raised for market in approximately the 408 - 590 kg (900 - 1300 lb) weight range.

Catch Basin
Any excavated, diked, or walled structure, or combination of structures designed to intercept and temporarily store runoff water contaminated by animal manure, wash water, or associated wastes.

Compost
A stable humus-like material that has been created by the bio-oxidation of manure.

Covered Facility
A livestock facility where livestock are confined within a building for growing or finishing for market.

Earthen Manure Storage
A structure constructed primarily of natural geological materials for liquid manure storage.

Electrical Conductivity (E.C.)
A measure of soil salinity. Soil salinity refers to the presence of excessive levels of dissolved inorganic salts. Electrical conductivity provides a practical measure of the total salt level in a soil. As the electrical conductivity level increases, the crop's ability to grow and utilize soil nutrients is reduced. The standard procedure for measuring electrical conductivity is in a saturated paste or a 1:2 soil - water suspension.

Expansion
An increase in the number of livestock within an intensive livestock operation.

Feedlot Facility
An uncovered livestock facility where livestock are confined solely for the purpose of growing or finishing, and are sustained by means other than grazing.

Freeboard
The distance between the full storage level and the upper edge of the storage structure. A 0.5 m (20 in.) freeboard is required to accommodate wave action.

Gleyed Layer
The relatively impervious layer formed by the hooves of ruminant animals in contact with livestock manure and underlying soil material in active feedlot pens.

Grazing Area
A pasture or rangeland where livestock are sustained primarily by feed/forage grown on the pasture or range land.

Groundwater Source
An underground formation capable of transmitting sufficient quantities of water for human consumption.

Incorporation
The mixing of land applied manure into the soil.

Intensive Livestock Operation (ILO)
The following definition may be used to define an intensive livestock operation as a conditional use under a Land Use Bylaw. Performance standards of this Code apply to all livestock operations and associated operations handling manure. The threshold numbers are used to determine when a livestock operation is considered an intensive livestock operation.

An ILO is deemed to have permanence, significant cost, service and resource requirements, and environmental and community implications. It should require a development permit if all of the following three criteria are met.

1. **Threshold Size**

   Any feedlot or covered facility of significant investment or permanence, capable of confining the minimum number of livestock set out in the table below.

Table 1. Intensive Livestock Operations - Minimum Size

Livestock Type	Threshold Number	Livestock Type	Threshold Number
Beef Finishers (900 - 1300 lbs)	300	Horses (PMU)	75
Beef Feeders (450 - 900 lbs)	400	Horses (feedlot)	100
Feeder Cows	200	Poultry (broilers)	920 m^2
Feeder Calves	400	Poultry (breeders)	500
Dairy Cows (milking)	All	Poultry (layers)	5000
Swine (farrow - finish)	30	Poultry (turkey broilers)	3000
Swine (farrow - wean)	50	Feeder Lambs	600
Swine (feeders only)	300	Goats (Dairy)	100
Swine (weaners)	500	Other	Discretionary

2. Density of Confinement

Livestock housed at a density of more than 1 livestock manure unit per 90 m^2 (968.4 ft^2) in open confinement.

3. Confinement Time Interval

Continuous confinement of at least 90 days.

The following are **not** considered an intensive livestock operation for the purpose of this Code:

- where livestock is confined for branding, sorting, herd health management and market delivery with confinement not exceeding 30 consecutive days, or
- livestock in intensive grazing management systems.

Livestock

Any farm animals and/or poultry reared for commercial purposes.

Livestock Facility

Buildings, shelters, fences, corrals, or other structures which confine or would be capable of confining livestock for feeding and rearing purposes, excluding croplands and grazing areas.

Livestock Manure Unit

The manure equivalent produced by a 450 kg (990 lb) beef animal for a 1 year period. A convention used to compare relative manure production between species.

Livestock Siting Unit (LSU)

A means of comparing the odour potential of livestock facilities based on livestock type, manure production, and manure handling system. The Livestock Siting Unit is the basis for the Minimum Distance Separation (MDS) method.

Long-term Solid Manure Storage

Solid manure stored for extended periods of time awaiting land spreading, sale, or further processing.

Manure Storage Facility

A structure, reservoir, catch basin, earthen storage, tank, or area with or without a constructed berm, for containing livestock manure prior to the manure being used or disposed. It does not include a vehicle or any mobile equipment used for transportation or disposal of livestock manure.

Minimum Distance Separation (MDS)

A setback or buffer established between an intensive livestock facility (source) and adjacent land uses (receptors) to minimize odour nuisance. Recommended separation distances are found in **Appendix D**. The LSU is the base unit for determining separation recommendations.

Nuisance

An annoyance, such as odours, flies, and dust.

Open Body of Water
The bed and shore of an irrigation canal, drainage canal, reservoir, river, stream, creek, lake, marsh, slough, or other body of water, but does not include the following:

(i) waterworks system;

(ii) reservoirs, lakes, marshes, or sloughs that are completely surrounded by private land controlled by the operator, have an area of less than 4 hectares (9.9 acres), and have no outflow of water beyond the private land;

(iii) irrigation and drainage canals that are completely surrounded by private land controlled by the operator and have no outflow beyond the private land;

(iv) roadside ditches;

(v) wastewater systems;

(vi) storm drain systems;

(vii) temporary streams on private land that do not flow beyond the boundaries of the land controlled by the operator.

Operator
A person responsible for the intensive livestock operation.

Professional Engineer
An engineer as defined in the *Engineering, Geological, Geo-Physical Professions Act of Alberta.*

Runoff
Any rainwater or meltwater that drains as surface or subsurface flow from the feeding and manure storage areas associated with the operation.

Run-on
Any rainwater or meltwater that drains as surface or subsurface flow into the feeding or manure storage areas associated with the operation.

Seasonal Livestock Feeding Site
An overwintering area where animals are fed and sheltered. Animals at such sites are primarily sustained by supplemental feeding.

Short-term Manure Storage
A temporary storage for solid manure to facilitate the spreading of solid manure on land due to climatic and seasonal constraints, and is only stored for a period not exceeding 6 months in a given location over a 3-year period.

Solid Livestock Manure
Livestock manure that is 20% or more solid matter and does not flow when piled.

Soil Plasticity
A plastic index, in combination with soil texture, is an indication of permeability, water holding capacity, and strength. Liquid limit is the moisture content at which a soil will flow freely. Plastic limit is the moisture content at which a 1/8 inch roll of soil will begin to crack.

Soil Texture
The relative amounts of sand, silt, and clay particles in a soil. Coarse textured soils have sand percentages of greater than 45% and include sands, loamy sands, sandy loam, sandy clay, and sandy clay loam soils. Medium to fine textured soils have sand percentages of less than 45% and include loam, clay loam, silt loam, silt, silty clay loam, silty clay, clay, and heavy clay soils.

Swine - Farrowing
A swine operation raising and marketing pigs to the time of weaning.

Swine - Farrow to Finish
A swine operation raising pigs from birth to market.

Swine - Farrow to Wean
A swine operation raising and marketing pigs to approximately 23 kg (50 lbs).

Swine - Feeder
A swine operation accepting pigs of approximately 23 kg (50 lbs) and raising to market size.

Swine - Weaner Nursery (Iso-wean)
A swine operation accepting weaners of approximately 5.5 kg (12 lbs) and growing to approximately 23 kg (50 lbs).

Temporary Manure Storage
The temporary storage of solid manure to facilitate land spreading, which has been delayed due to climatic and seasonal constraints.

Water Well
An opening in the ground, whether drilled or altered from its natural state, that is used for:

(i) the production of groundwater for any purpose, or

(ii) obtaining data on groundwater, or

(iii) recharging an underground formation from which groundwater can be recovered, and includes any related equipment, buildings, structures, and appurtenances.

Appendices

Appendix A
Nutrient Content of Typical Agricultural Livestock Manures for Various Species 34

Appendix B
Manure Production Volumes for Various Livestock Types 36

Appendix C
Livestock Siting Units and Expansion Factors 38

Appendix D
Minimum Distance Separation Tables 41

Appendix E
Land Base Guidelines for Livestock Operations 64

Appendix F
Estimating Runoff Volume from Open Lots 75

Appendix A

Nutrient Content of Typical Agricultural Livestock Manures for Various Species

Explanation of Appendix A:

Total N: Includes both mineral (nitrate and ammonium nitrogen) and organic nitrogen. The organic portion is not available to the plant without further microbial mineralization into available nitrogen.

Available N: This is the portion of the total nitrogen that is in the mineral (usually ammonium), plant available form at the time of application.

Crop N: This is an estimate of the available nitrogen plus the portion of the organic nitrogen that is mineralized over the growing season less estimated losses.

Total P: Total P is expressed as total phosphorus in the manure including mineral and organic forms. Phosphorus is largely contained in the solids portion of the manure so mixing of the liquid manure is necessary for uniformity of phosphorus content.

Total K: Total K is expressed as total potassium in the manure.

Appendix A-1: Nutrient Content of Typical Agricultural Livestock Manures for Various Species

Type of Livestock		Moisture %	Total N % Range	Total N - Typical		Available N		Crop N		Total P		Total K	
				lbs/ton	kg/tonne	lbs/ton	kg/tonne	lbs/ton	kg/tonne	lbs/ton	kg/tonne	lbs/ton	kg/tonne
Beef	Feeders Finishers Feeder Calves Cow w/Calf Cows/Bulls	30 - 70 (50)	0.65 - 1.25	20.0	10.0	5.1	2.6	6.5	3.2	4.8	2.4	13.3	6.7
	Paved Feedlot	50 - 75 (65)	0.45 - 0.80	14.0	7.0	5.4	2.7	5.0	2.5	1.7	0.9	7.5	3.8
Dairy	Free stall	85 - 95 (92)	0.35 - 0.60	8.0	4.0	3.6	1.8	3.3	1.7	1.7	0.9	8.3	4.2
	Tie stall Loose Housing Replacements Calves	70 - 85 (80)	0.45 - 0.65	10.0	5.0	4.2	2.1	3.8	1.9	1.7	0.9	8.3	4.2
Swine	Liquid	90 - 99 (96)	0.20 - 0.55	7.0	3.5	3.2	1.6	3.1	1.6	2.2	1.1	3.3	1.7
	Solid	40 - 70 (50)	0.60 - 0.90	16.0	8.0	6.4	3.2	6.2	3.1	3.0	1.5	4.6	2.3
Poultry	Layers (solid) Belt cage	30 - 60 (40)	2.50 - 3.50	60.0	30.1	40.0	20.1	37.7	18.9	30.8	15.4	20.0	10.0
	Layers (solid) Deep Pit	30 - 60 (50)	2.00 - 3.00	48.0	24.1	32.0	16.0	30.1	15.1	24.6	12.3	16.6	8.3
	Layers (liquid)	85 - 95 (90)	0.50 - 1.00	12.0	6.0	8.0	4.0	7.5	3.8	5.0	2.5	4.0	2.0
	Broilers Pullets	30 - 50 (35)	3.50 - 4.00	68.0	34.1	38.9	19.5	36.8	18.4	19.0	9.5	20.0	10.0
	Breeders	30 - 50 (35)	1.60 - 2.10	60.0	30.1	34.3	17.2	32.4	16.3	19.0	9.5	20.0	10.0
Turkey Breeders		30 - 50 (35)	1.50 - 2.00	35.0	17.5	20.0	10.0	18.9	9.5	11.8	5.9	12.5	6.3
Horses	Feedlot	30 - 60 (50)	1.00 - 2.00	30.0	15.0	15.0	7.5	14.3	7.1	4.6	2.3	20.8	10.4
	PMU	50 - 80 (75)	0.50 - 0.70	12.0	6.0	6.0	3.0	5.7	2.9	2.6	1.3	10.0	5.0
	Donkeys Mules	30 - 70 (50)	0.80 - 1.10	20.0	10.0	10.0	5.0	9.5	4.8	4.6	2.3	20.8	10.4
Fur Farms	Mink	-----	1.50 - 2.00	36.0	18.0	18.0	9.0	17.1	8.6	21.7	10.9	33.3	16.7
	Fox	-----	0.20 - 0.60	8.0	4.0	4.0	2.0	3.8	1.9	1.7	0.9	1.7	0.8
Rabbit		-----	0.30 - 0.60	10.0	5.0	4.2	2.1	4.6	2.3	10.4	5.2	8.3	4.2
Cervid	Elk Deer	25 - 50 (35)	0.50 - 0.75	13.0	6.5	3.9	2.0	4.5	2.2	4.3	2.2	10.0	5.0
Bison		25 - 50 (35)	0.50 - 0.75	13.0	6.5	3.9	2.0	4.5	2.2	4.3	2.2	10.0	5.0
Alpaca/Llama		25 - 50 (35)	0.80 - 1.20	20.0	10.0	8.0	4.0	7.2	3.6	3.9	2.0	20.8	10.4
Sheep	Ewes w/Lambs Ewes/Rams Feeders	30 - 65 (50)	0.65 - 1.25	20.0	10.0	8.0	4.0	7.2	3.6	3.9	2.0	20.8	10.4
	Lambs	30 - 65 (50)	0.50 - 1.00	14.0	7.0	5.6	2.8	5.0	2.5	3.9	2.0	20.8	10.4
Goats		30 - 65 (50)	0.50 - 0.75	12.6	6.3	5.0	2.5	4.5	2.3	4.6	2.3	20.8	10.4
Ratite		25 - 50 (35)	1.50 - 2.00	35.0	17.5	20.0	10.0	18.9	9.5	11.8	5.9	12.5	6.3

Appendix B

Manure Production Volumes for Various Livestock Types

Explanation of Appendix B:

The following values are the average manure volumes expected from common livestock species. Volumes are from typical housing systems and include added water (spillage, wash and precipitation) as well as bedding and spilled feed. These variables should be taken into account and adjustments made where appropriate. These volumes are used to determine recommended manure storage volumes and land spreading.

Appendix B-1: Solid Manure Production Volume

Species		Daily			Monthly			Yearly		
		lbs	kgs	cu. ft.	lbs	kgs	cu. ft.	tons	tonnes	cu. ft.
Beef	Feeders	8.4	3.8	0.21	250	110	6.2	1.53	1.39	75
	Finishers - Open Lot	13.1	5.9	0.32	390	180	9.6	2.38	2.16	117
	Finishers - Paved Lot	19.8	9.0	0.43	590	270	12.8	3.61	3.28	156
	Feeder Calves < 550 lbs	3.3	1.5	0.08	100	50	2.4	0.59	0.54	29
	Cow w/Calf	17.8	8.1	0.44	530	240	13.1	3.25	2.95	159
	Cows/Bulls	16.5	7.5	0.40	500	230	12.1	3.02	2.73	147
Dairy	Tie stall	139.7	63.5	2.66	4190	1900	79.7	25.50	23.12	970
	Loose housing	146.3	66.5	2.78	4390	2000	83.5	26.71	24.21	1016
	Replacements	42.9	19.5	0.82	1290	590	24.5	7.83	7.10	298
	Calves	2.9	1.3	0.07	90	40	2.1	0.54	0.49	26
Swine	Farrow to Finish	86.4	39.3	1.74	2590	1180	52.3	15.76	14.29	637
	Farrow to Wean	26.6	12.1	0.54	800	360	16.1	4.85	4.40	196
	Farrowing	21.3	9.7	0.43	640	290	12.9	3.88	3.52	157
	Weaner	2.8	1.3	0.06	80	40	1.7	0.50	0.46	20
	Feeder	8.2	3.7	0.17	250	110	5.0	1.50	1.36	61
Poultry per 100	Layers - Belt Cage	9.9	4.5	0.41	300	140	12.3	1.81	1.64	149
	Layers - Deep Pit	13.0	5.9	0.31	390	180	9.2	2.37	2.15	112
	Broilers	5.98	2.7	0.30	180	82	8.9	1.09	0.99	108
	Broiler Breeders	15.8	7.2	0.59	480	220	17.8	2.89	2.62	217
	Layer Breeders	11.7	5.3	0.53	350	160	15.8	2.13	1.93	192
	Pullets	6.0	2.7	0.15	180	80	4.6	1.09	0.99	56
	Turkey Hens (Light)	13.6	6.0	0.85	410	190	25.4	2.49	2.26	309
	Turkey Toms (Heavy)	19.8	9.0	1.28	590	270	38.5	3.61	3.28	468
	Turkey Broilers	11.0	5.0	0.51	330	150	15.3	2.01	1.82	186

Appendix B-1: Solid Manure Production Volume (contd.)

Species		Daily			Monthly			Yearly		
		lbs	kgs	cu. ft.	lbs	kgs	cu. ft.	tons	tonnes	cu. ft.
Horses	PMU	45.8	20.8	0.92	1370	620	27.7	8.35	7.57	337
	Feedlot	15.2	7.0	0.46	460	210	13.9	2.77	2.51	169
	Donkeys	7.6	3.0	0.23	230	100	6.9	1.39	1.26	84
	Mules	11.4	5.0	0.35	340	150	10.4	2.08	1.89	127
Fur Farms	Mink (per 100)	30.8	14.0	0.71	920	420	21.3	5.62	5.10	260
	Fox (per 100)	77.0	35.0	1.24	2310	1050	37.3	14 05	12.74	454
Rabbits (per 100)		100.1	45.5	2.49	3000	1360	74.7	18.27	16.56	908
Cervid	Elk	5 8	2.6	0.14	170	77	4.3	1.06	0.96	52
	Deer	2.9	1.3	0.07	90	40	2.1	0.52	0.47	25
Bison		7.3	3.3	0.18	220	100	5.3	1 32	1.20	65
Alpaca/Llama		4.6	2.1	0.15	140	60	4 5	0 84	0.76	55
Sheep	Ewes w/Lambs	3 9	1.8	0.13	120	55	3 8	0.71	0.64	46
	Ewes/Rams	3 1	1.4	0.10	90	41	3 0	0.57	0.51	37
	Feeders	1 5	0.7	0.05	50	23	1 5	0 28	0.25	18
	Lambs	0.8	0.4	0.02	23	11	0.7	0.14	0.13	9
Goats	Meat/Milk per Ewe	5 9	2.7	0.19	180	80	5.8	1.08	0.98	70
	Feeders	0.6	0.3	0.02	20	10	0.5	0 10	0.09	6
	Nannies/Billies	3.1	1.4	0.10	90	40	3.0	0.56	0.51	36
Ratite	Emu	1.3	0.6	0.08	40	20	2.4	0.24	0.22	29
	Ostrich	2.4	1.1	0.15	70	30	4.4	0.44	0.40	53

Appendix B-2: Liquid Manure Production Volume

Species		Daily			Monthly			Yearly		
		gallons	litres	cu. ft.	gallons	litres	cu. ft.	gallons	cu. m	cu. ft
Swine	Farrow to Finish	14.44	65.7	2.31	433	1970	69	5270	24.0	844
	Farrow to Wean	4.44	20.2	0.71	133	610	21	1620	7.4	260
	Farrowing	3.50	15.9	0.56	105	480	17	1280	5.8	204
	Weaner	0.50	2.3	0.08	15	70	2	180	0.82	29
	Feeder	1.56	7.3	0.25	47	210	7	570	2.6	91
Dairy - Free Stall		18.86	86	3.02	566	2570	91	6890	31	1102
Poultry - Layers (per 100)		5.96	27	0.95	179	810	29	2170	10	350

Appendix C

Livestock Siting Units and Expansion Factors

Explanation of Appendix C:

This table provides the factors for determining the minimum distance separation (MDS) between livestock facilities of an intensive livestock operation and surrounding neighbours. The Livestock Siting Unit (LSU) is the result of multiplying the following factors:

Factor A: The relative nuisance of various livestock types.

Factor D: The contribution of the manure management system to the nuisance level.

MU Reciprocal: This factor takes into account the relative size of the animal, therefore the amount of manure produced.

The Livestock Siting Unit (LSU) factor multiplied by the number of livestock can be looked up in **Appendix D-11** to give the required MDS for the livestock facility. See **Appendix D** for pre-calculated tables for the common livestock types.

Appendix C-1: Livestock Siting Unit Table for Various Livestock Types*

Species		Factor A	Factor D	MU Recip.	LSU Factor
Beef	Feeders 450 - 900 lbs (Feedlot)	0.700	0.700	0.500	0.245
	Feeders 450 - 900 lbs (Semi Feedlot)	0.700	0.600	0.500	0.210
	Feeder Calves < 550 lbs	0.700	0.700	0.275	0.135
	Finishers 900 - 1300 lbs (Open Lot)	0.700	0.700	0.910	0.446
	Finishers 900 - 1300 lbs (Paved Lot)	0.700	0.700	0.910	0.446
	Cow with Calf	0.600	0.600	1.200	0.432
	Cows/Bulls	0.700	0.600	1.200	0.504
Dairy	Milking Cows - Free stall (incl. dries)	0.800	1.100	1.640	1.443
	Milking Cows - Free stall (total)	0.800	1.100	2.000	1.760
	Milking Cows - Tie stall (incl. dries)	0.800	1.000	1.640	1.312
	Milking Cows - Loose housing (incl dries)	0.800	1.000	1.640	1.312
	Replacements	0.800	0.700	0.600	0.336
	Heifers	0.800	0.700	0.700	0.392
	Calves	0.800	0.700	0.200	0.112
Swine - Liquid	Farrow to Finish	2.000	1.100	1.780	3.916
	Farrow to Wean	2.000	1.100	0.670	1.474
	Farrowing	2.000	1.100	0.530	1.166
	Weaner	2.000	1.100	0.055	0.121
	Feeder	2.000	1.100	0.200	0.440

* LSU for other livestock types to be determined by AAFRD.

Appendix C-1: Livestock Siting Unit Table for Various Livestock Types* (contd.)

Species		Factor A	Factor D	MU Recip.	LSU Factor
Swine - Solid	Farrow to Finish	2.000	0.800	1.780	2.848
	Farrow to Wean	2.000	0.800	0.670	1.072
	Farrowing	2.000	0.800	0.530	0.848
	Weaner	2.000	0.800	0.055	0.088
	Feeder	2.000	0.800	0.200	0.320
Poultry	Broilers	1.000	0.700	0.002	0.0014
	Breeders	1.000	0.700	0.010	0.0070
	Layers (Solid)	2.000	0.700	0.008	0.0112
	Layers (Liquid)	2.000	1.100	0.008	0.0176
	Pullets	1.000	0.700	0.002	0.0014
	Turkey Hens (Light)	1.000	0.700	0.013	0.0091
	Turkey Toms (Heavy)	1.000	0.700	0.020	0.0140
	Turkey Broilers	1.000	0.700	0.010	0.0070
	Turkey Breeders	1.000	0.700	0.020	0.0140
Horses	Feedlot	0.650	0.700	1.000	0.455
	PMU	0.650	1.100	1.000	0.715
	Mules	0.600	0.700	0.670	0.281
	Donkeys	0.600	0.700	1.000	0.420
Goats	Dairy	0.700	0.700	0.170	0.0833
	Meat	0.700	0.700	0.170	0.0833
	Nannies/Billies	0.700	0.700	0.170	0.0833
	Feeders	0.700	0.700	0.077	0.0377
Sheep	Ewes with Lambs	0.600	0.700	0.250	0.105
	Ewes/Rams	0.600	0.700	0.200	0.084
	Lambs	0.600	0.700	0.050	0.021
	Feeders	0.600	0.700	0.100	0.042
Cervids	Elk	0.600	0.700	0.600	0.252
	Deer	0.600	0.700	0.200	0.084
Bison		0.600	0.700	1.000	0.420
Alpaca/Llama		0.600	0.700	0.400	0.168

* LSU for other livestock types to be determined by AAFRD.

Appendix C-1: Livestock Siting Unit Table for Various Livestock Types* (contd.)

Species		Factor A	Factor D	MU Recip.	LSU Factor
Fur Farms	Mink	2.500	0.700	0.013	0.023
	Fox	2.500	0.700	0.025	0.044
Rabbits		0.850	0.700	0.020	0.012
Ratites	Emu	0.600	0.600	0.167	0.060
	Ostrich	0.600	0.600	0.250	0.090

* LSU for other livestock types to be determined by AAFRD.

Appendix C-2: Expansion Factors*

Expansion %	Factor
0 - 29	0.6
30 - 99	0.7
100 - 199	0.8
200 - 299	0.9
> 300	1.0

* See Section 1.1.1.2 for use of expansion factors.

Appendix D

Minimum Distance Separation Tables

Explanation of Appendix D:

Category 1: Land zoned for agricultural purposes (e.g. farmstead, acreage residences).

Category 2: Land zoned for non-agricultural purposes (e.g. country residential, rural commercial businesses).

Category 3: Land zoned as large scale country residential, high use recreational, or commercial purposes, as well as from the urban fringe boundary of land zoned as rural hamlet, village, or town which has an urban fringe.

Category 4: Land zoned as rural hamlet, village, or town without an urban fringe.

Note: All of the minimum distance separation values contained in Appendices D-1 to D-11 are for new developments. For the purpose of this Code and the use of the MDS method, expanding intensive livestock operations may have an expansion factor (Appendix C-2) applied to the LSU factor, thereby giving different MDS values from those required for new developments.

Appendix D-1: Recommended MDS for Beef Feeders*

No. of Animals	Minimum Distance Separation (metres)				No. of Animals	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
300	197	263	328	525	300	646	861	1077	1723
400	219	292	365	583	400	718	957	1196	1914
500	237	316	396	633	500	778	1038	1297	2076
600	254	338	423	676	600	832	1109	1387	2219
700	268	358	447	716	700	880	1174	1467	2347
800	282	376	470	751	800	924	1232	1540	2464
900	294	392	490	784	900	965	1286	1608	2573
1000	306	408	509	815	1000	1003	1337	1671	2674
1200	327	436	545	871	1200	1072	1429	1786	2858
1400	346	461	576	922	1400	1134	1511	1889	3023
1600	363	484	605	968	1600	1190	1587	1984	3174
1800	379	505	631	1010	1800	1243	1657	2071	3313
2000	394	525	656	1050	2000	1291	1722	2152	3443
2500	427	569	712	1139	2500	1401	1868	2335	3735
3000	456	609	761	1217	3000	1497	1996	2945	3992
3500	483	644	805	1288	3500	1584	2112	2640	4224
4000	507	676	845	1352	4000	1663	2217	2772	4435
5000	550	733	917	1467	5000	1804	2405	3007	4811
6000	588	784	980	1568	6000	1928	2571	3214	5142
7000	622	829	1036	1658	7000	2040	2720	3400	5439
8000	653	871	1088	1741	8000	2142	2856	3569	5711
9000	682	909	1136	1818	9000	2236	2981	3726	5962
10000	708	944	1181	1889	10000	2323	3098	3872	6196
12000	757	1009	1262	2019	12000	2483	3311	4139	6622
14000	801	1068	1335	2136	14000	2627	3503	4378	7005
16000	841	1121	1402	2242	16000	2758	3678	4597	7355
18000	878	1170	1463	2341	18000	2879	3839	4799	7678
20000	912	1216	1520	2433	20000	2992	3990	4987	7979
25000	990	1320	1649	2639	25000	3246	4328	5410	8657
30000	1058	1410	1763	2821	30000	3470	4626	5783	9252
40000	1175	1567	1958	3133	40000	3854	5138	6423	10277
50000	1275	1699	2124	3399	50000	4181	5574	6968	11149

* Beef animals in the 200 - 400 kg (450 - 900 lbs) weight range.

Appendix D-2: Recommended MDS for Beef Finishers*

No. of Animals	Minimum Distance Separation (metres)				No. of Animals	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
300	245	327	409	654	300	804	1072	1340	2144
400	272	363	454	726	400	893	1191	1488	2381
500	295	394	492	788	500	969	1292	1615	2583
600	316	421	526	842	600	1035	1381	1726	2761
700	334	445	557	891	700	1095	1460	1826	2921
800	351	467	584	935	800	1150	1533	1917	3067
900	366	488	610	976	900	1201	1601	2001	3202
1000	380	507	634	1014	1000	1248	1664	2079	3327
1200	407	542	678	1084	1200	1333	1778	2222	3556
1400	430	573	717	1147	1400	1411	1881	2351	3762
1600	452	602	753	1204	1600	1481	1975	2469	3950
1800	471	629	786	1257	1800	1546	2062	2577	4123
2000	490	653	816	1306	2000	1607	2142	2678	4285
2500	531	709	886	1417	2500	1743	2324	2905	4648
3000	568	757	947	1515	3000	1863	2484	3105	4968
3500	601	801	1001	1602	3500	1971	2628	3285	5256
4000	631	841	1052	1682	4000	2069	2759	3449	5518
5000	684	913	1141	1825	5000	2245	2993	3742	5987
6000	732	975	1219	1951	6000	2399	3199	3999	6399
7000	774	1032	1290	2064	7000	2538	3384	4231	6769
8000	813	1083	1354	2167	8000	2665	3553	4442	7107
9000	848	1131	1414	2262	9000	2782	3710	4637	7419
10000	881	1175	1469	2351	10000	2891	3855	4819	7710
12000	942	1256	1570	2512	12000	3090	4120	5150	8241
14000	997	1329	1661	2658	14000	3269	4359	5448	8718
16000	1046	1395	1744	2791	16000	3432	4576	5721	9153
18000	1092	1457	1821	2913	18000	3583	4778	5972	9555
20000	1135	1514	1892	3027	20000	3724	4965	6206	9930
25000	1232	1642	2053	3284	25000	4040	5386	6733	10772
30000	1316	1755	2194	3510	30000	4318	5757	7196	11513
40000	1462	1949	2437	3899	40000	4796	6394	7993	12788
50000	1585	2115	2644	4230	50000	5203	6937	8671	13873

* Beef animals in the 400 - 500 kg (900 - 1300 lbs) weight range.

Appendix D-3A: Recommended MDS for Swine - Farrow to Finish (solid manure)*

No. of Sows	Minimum Distance Separation (metres)				No. of Sows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
50	251	334	418	669	50	822	1097	1371	2193
100	323	431	538	861	100	1059	1412	1765	2825
125	350	467	584	934	125	1149	1532	1915	3064
150	374	499	624	999	150	1228	1638	2047	3275
175	396	528	660	1056	175	1299	1732	2165	3465
200	416	555	693	1109	200	1364	1819	2274	3638
250	451	602	752	1203	250	1480	1973	2467	3946
300	482	643	804	1286	300	1582	2109	2636	4218
350	510	680	850	1360	350	1673	2231	2789	4462
400	536	714	893	1428	400	1757	2342	2928	4685
500	581	775	968	1550	500	1906	2541	3177	5083
600	621	828	1035	1656	600	2037	2716	3395	5432
750	674	898	1123	1797	750	2210	2947	3683	5893
1000	748	998	1247	1996	1000	2455	3273	4091	6546
1500	868	1157	1446	2314	1500	2846	3795	4744	7590
2000	964	1285	1606	2570	2000	3161	4215	5269	8430
2500	1046	1394	1743	2788	2500	3430	4573	5716	9145
3000	1118	1490	1863	2980	3000	3666	4887	6109	9775
3500	1182	1576	1970	3153	3500	3878	5170	6463	10341
4000	1241	1655	2069	3310	4000	4071	5428	6786	10857
5000	1347	1795	2244	3591	5000	4417	5889	7361	11778
10000	1734	2312	2890	4625	10000	5688	7585	9481	15169
15000	2011	2681	3351	5362	15000	6596	8794	10993	17589
20000	2234	2978	3723	5956	20000	7326	9768	12210	19536

* Swine operation raising hogs from birth to market. Size is based on farrowing sow herd and includes all associated hogs.

Appendix D-3B: Recommended MDS for Swine - Farrow to Finish (liquid manure)*

No. of Sows	Minimum Distance Separation (metres)				No. of Sows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
50	282	376	469	751	50	924	1232	1540	2464
100	363	484	605	967	100	1190	1586	1983	3173
125	394	525	656	1049	125	1291	1721	2151	3442
150	421	561	701	1122	150	1380	1839	2299	3679
175	445	593	742	1187	175	1459	1946	2432	3892
200	467	623	779	1246	200	1532	2043	2554	4086
250	507	676	845	1351	250	1662	2216	2771	4433
300	542	722	903	1444	300	1777	2369	2961	4738
350	573	764	955	1528	350	1880	2506	3133	5012
400	602	802	1003	1604	400	1973	2631	3289	5262
500	653	870	1088	1741	500	2141	2855	3568	5709
600	698	930	1163	1860	600	2288	3051	3814	6102
750	757	1009	1261	2018	750	2482	3310	4137	6620
1000	841	1121	1401	2242	1000	2757	3676	4595	7353
1500	975	1300	1624	2599	1500	3197	4263	5328	8525
2000	1083	1443	1804	2887	2000	3551	4735	5918	9469
2500	1174	1566	1957	3132	2500	3852	5136	6420	10273
3000	1255	1674	2092	3347	3000	4117	5490	6862	10980
3500	1328	1771	2213	3541	3500	4356	5808	7259	11615
4000	1394	1859	2324	3718	4000	4573	6098	7622	12195
5000	1513	2017	2521	4034	5000	4961	6615	8269	13230
10000	1948	2597	3247	5195	10000	6390	8519	10649	17039
15000	2259	3012	3765	6023	15000	7409	9878	12348	19757
20000	2509	3345	4181	6690	20000	8229	10972	13715	21944

* Swine operation raising hogs from birth to market. Size is based on farrowing sow herd and includes all associated hogs.

Appendix D-4A: Recommended MDS for Swine - Farrowing (solid manure)*

No. of Sows	Minimum Distance Separation (metres)				No. of Sows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
50	161	215	269	430	50	529	705	881	1409
100	208	277	346	553	100	681	908	1134	1815
125	225	300	375	600	125	738	985	1231	1969
150	241	321	401	642	150	789	1052	1315	2105
175	255	339	424	679	175	835	1113	1392	2227
200	267	356	445	713	200	877	1169	1461	2338
250	290	387	483	773	250	951	1268	1585	2536
300	310	413	516	826	300	1016	1355	1694	2711
350	328	437	546	874	350	1075	1434	1792	2867
400	344	459	574	918	400	1129	1505	1882	3011
500	373	498	622	996	500	1225	1633	2041	3266
600	399	532	665	1064	600	1309	1745	2182	3491
750	433	577	722	1155	750	1420	1894	2367	3787
1000	481	641	802	1282	1000	1577	2103	2629	4206
1500	558	744	929	1487	1500	1829	2439	3048	4877
2000	619	826	1032	1652	2000	2032	2709	3386	5417
2500	672	896	1120	1792	2500	2204	2939	3673	5877
3000	718	958	1197	1915	3000	2356	3141	3926	6282
3500	760	1013	1266	2026	3500	2492	3323	4153	6645
4000	798	1064	1329	2127	4000	2616	3488	4361	6977
5000	865	1154	1442	2308	5000	2838	3784	4731	7569
8000	1027	1370	1712	2739	8000	3370	4493	5616	8986
10000	1114	1486	1857	2972	10000	3655	4874	6092	9748
15000	1292	1723	2154	3446	15000	4239	5651	7064	11303
20000	1435	1914	2392	3828	20000	4708	6277	7846	12554

* Swine operation raising hogs from birth to 5 - 6 kg (11 - 13 lbs). Size based on farrowing sow herd and all associated hogs.

Appendix D-4B: Recommended MDS for Swine - Farrowing (liquid manure)*

No. of Sows	Minimum Distance Separation (metres)				No. of Sows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
50	181	241	302	483	50	594	792	989	1583
100	233	311	389	622	100	765	1019	1274	2039
125	253	337	421	674	125	829	1106	1382	2212
150	270	360	450	721	150	887	1182	1478	2364
175	286	381	477	762	175	938	1250	1563	2501
200	300	400	500	801	200	985	1313	1641	2626
250	326	434	543	868	250	1068	1424	1780	2849
300	348	464	580	928	300	1142	1522	1903	3045
350	368	491	614	982	350	1208	1610	2013	3221
400	387	516	644	1031	400	1268	1691	2114	3382
500	419	559	699	1119	500	1376	1834	2293	3669
600	448	598	747	1195	600	1470	1961	2451	3921
750	486	648	811	1297	750	1595	2127	2659	4254
1000	540	720	900	1441	1000	1772	2362	2953	4725
1500	626	835	1044	1670	1500	2054	2739	3424	5479
2000	696	928	1160	1855	2000	2282	3043	3803	6085
2500	755	1006	1258	2013	2500	2476	3301	4126	6602
3000	807	1076	1344	2151	3000	2646	3528	4410	7056
3500	853	1138	1422	2276	3500	2799	3732	4665	7464
4000	896	1195	1493	2389	4000	2939	3918	4898	7837
5000	972	1296	1620	2592	5000	3188	4251	5314	8502
8000	1154	1539	1923	3077	8000	3785	5047	6308	10093
10000	1252	1669	2086	3338	10000	4106	5475	6843	10950
15000	1452	1935	2419	3871	15000	4761	6348	7935	12696
20000	1612	2150	2687	4299	20000	5288	7051	8814	14102

* Swine operation raising hogs from birth to 5 - 6 kg (11 - 13 lbs). Size based on farrowing sow herd and all associated hogs.

Appendix D-5A: Recommended MDS for Swine - Farrow to Wean (solid manure)*

No. of Sows	Minimum Distance Separation (metres)				No. of Sows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
50	176	234	293	468	50	576	768	960	1535
100	226	301	377	603	100	741	989	1236	1977
125	245	327	409	654	125	804	1073	1341	2145
150	262	349	437	699	150	860	1146	1433	2293
175	277	370	462	739	175	910	1213	1516	2425
200	291	388	485	776	200	955	1273	1592	2547
250	316	421	526	842	250	1036	1381	1727	2763
300	338	450	563	900	300	1107	1476	1845	2953
350	357	476	595	952	350	1171	1562	1952	3124
400	375	500	625	1000	400	1230	1640	2050	3280
500	407	542	678	1085	500	1334	1779	2224	3558
600	435	580	725	1159	600	1426	1901	2377	3803
750	472	629	786	1258	750	1547	2063	2578	4125
1000	524	699	873	1397	1000	1718	2291	2864	4582
1500	607	810	1012	1620	1500	1992	2657	3321	5313
2000	675	900	1124	1799	2000	2213	2951	3688	5901
2500	732	976	1220	1952	2500	2401	3201	4001	6402
3000	782	1043	1304	2086	3000	2566	3421	4277	6843
3500	828	1103	1379	2207	3500	2714	3619	4524	7239
4000	869	1159	1448	2317	4000	2850	3800	4750	7600
5000	943	1257	1571	2514	5000	3092	4123	5153	8245
8000	1119	1492	1865	2984	8000	3671	4894	6118	9788
10000	1214	1619	2023	3237	10000	3982	5309	6637	10619
15000	1408	1877	2346	3754	15000	4617	6156	7695	12312
20000	1564	2085	2606	4169	20000	5128	6838	8547	13676

* Swine operation raising hogs from birth to 23 kg (50 lbs). Size based on farrowing sow herd and all associated hogs.

Appendix D-5B: Recommended MDS for Swine - Farrow to Wean (liquid manure)*

No. of Sows	Minimum Distance Separation (metres)				No. of Sows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
50	197	263	329	526	50	647	862	1078	1725
100	254	339	423	677	100	833	1111	1388	2221
125	275	367	459	735	125	904	1205	1506	2409
150	294	393	491	785	150	966	1288	1610	2575
175	311	415	519	831	175	1022	1362	1703	2724
200	327	436	545	872	200	1073	1430	1788	2860
250	355	473	591	946	250	1164	1552	1939	3103
300	379	506	632	1011	300	1244	1658	2073	3317
350	401	535	669	1070	350	1316	1754	2193	3509
400	421	562	702	1123	400	1381	1842	2302	3684
500	457	609	762	1218	500	1499	1998	2498	3996
600	488	651	814	1302	600	1602	2136	2670	4271
750	530	706	883	1413	750	1738	2317	2896	4634
1000	588	785	981	1569	1000	1930	2573	3217	5147
1500	682	910	1137	1819	1500	2238	2984	3730	5968
2000	758	1010	1263	2021	2000	2486	3314	4143	6629
2500	822	1096	1370	2192	2500	2697	3596	4494	7191
3000	879	1172	1465	2343	3000	2882	3843	4804	7686
3500	930	1239	1549	2479	3500	3049	4065	5082	8131
4000	976	1301	1627	2603	4000	3201	4268	5336	8537
5000	1059	1412	1765	2824	5000	3473	4631	5788	9261
8000	1257	1676	2095	3352	8000	4123	5497	6872	10995
10000	1364	1818	2273	3636	10000	4473	5964	7455	11928
15000	1581	2108	2635	4216	15000	5186	6915	8644	13830
20000	1756	2342	2927	4683	20000	5760	7681	9601	15361

* Swine operation raising hogs from birth to 23 kg (50 lbs). Size based on farrowing sow herd and all associated hogs.

Appendix D-6A: Recommended MDS for Swine - Weaners (solid manure)*

No. of Weaners	Minimum Distance Separation (metres)				No. of Weaners	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
500	163	218	272	436	500	536	714	893	1429
600	175	233	291	466	600	573	763	954	1527
700	185	246	308	492	700	606	808	1010	1615
800	194	259	323	517	800	636	848	1060	1696
900	202	270	337	540	900	664	885	1107	1770
1000	210	280	351	561	1000	690	920	1150	1840
1500	244	325	407	650	1500	800	1067	1333	2133
2000	271	361	452	722	2000	889	1185	1481	2370
2500	294	392	490	784	2500	964	1285	1607	2571
3000	314	419	524	838	3000	1030	1374	1717	2747
4000	349	465	581	930	4000	1144	1526	1907	3052
5000	379	505	631	1009	5000	1241	1655	2069	3311
6000	405	539	674	1079	6000	1327	1769	2212	3538
7000	428	571	713	1141	7000	1404	1872	2340	3743
8000	449	599	749	1198	8000	1474	1965	2456	3930
9000	469	625	782	1251	9000	1539	2051	2564	4103
10000	487	650	812	1300	10000	1599	2132	2665	4264
15000	565	754	942	1507	15000	1854	2472	3090	4944
20000	628	837	1046	1674	20000	2059	2746	3432	5491
25000	681	908	1135	1816	25000	2234	2979	3723	5957
30000	728	971	1213	1941	30000	2388	3184	3979	6367
40000	809	1078	1348	2156	40000	2652	3536	4420	7072
50000	877	1170	1462	2339	50000	2877	3836	4795	7672

* Swine operation housing piglets in a 6 - 23 kg (13 - 50 lbs) weight range.

Appendix D-6B: Recommended MDS for Swine - Weaners (liquid manure)*

No. of Weaners	Minimum Distance Separation (metres)				No. of Weaners	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
500	183	245	306	489	500	602	802	1003	1605
600	196	261	327	523	600	643	858	1072	1715
700	207	277	346	553	700	680	907	1134	1814
800	218	290	363	581	800	714	952	1191	1905
900	227	303	379	606	900	746	994	1243	1989
1000	236	315	394	630	1000	775	1033	1292	2067
1500	274	365	457	731	1500	899	1198	1498	2396
2000	304	406	507	811	2000	998	1331	1663	2662
2500	330	440	550	880	2500	1083	1444	1805	2887
3000	353	470	588	941	3000	1157	1543	1929	3086
4000	392	523	653	1045	4000	1285	1714	2142	3428
5000	425	567	709	1134	5000	1395	1859	2324	3719
6000	454	606	757	1212	6000	1490	1987	2484	3975
7000	481	641	801	1282	7000	1577	2102	2628	4205
8000	505	673	841	1346	8000	1655	2207	2759	4415
9000	527	703	878	1405	9000	1728	2304	2880	4609
10000	548	730	913	1460	10000	1796	2395	2993	4789
15000	635	847	1058	1693	15000	2082	2777	3471	5553
20000	705	940	1175	1880	20000	2313	3084	3855	6168
25000	765	1020	1275	2040	25000	2509	3346	4182	6691
30000	818	1090	1363	2180	30000	2682	3576	4470	7152
40000	908	1211	1514	2422	40000	2979	3972	4965	7944
50000	985	1314	1642	2627	50000	3232	4309	5386	8618

* Swine operation housing piglets in a 6 - 23 kg (13 - 50 lbs) weight range.

Appendix D-7A: Recommended MDS for Swine - Feeders (solid manure)*

No. of Feeders	Minimum Distance Separation (metres)				No. of Feeders	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
100	150	193	242	388	100	492	636	795	1272
500	262	349	436	698	500	858	1144	1430	2289
600	280	373	466	746	600	917	1223	1529	2446
750	303	405	506	809	750	995	1327	1658	2654
1000	337	449	562	899	1000	1105	1474	1842	2947
1200	360	480	600	960	1200	1181	1575	1969	3150
1500	391	521	651	1042	1500	1282	1709	2136	3417
2000	434	579	723	1157	2000	1423	1898	2372	3796
2500	471	628	785	1255	2500	1544	2059	2574	4118
3000	503	671	839	1342	3000	1650	2201	2751	4401
3500	532	710	887	1420	3500	1746	2328	2910	4656
4000	559	745	932	1490	4000	1833	2444	3055	4889
4500	583	778	972	1556	4500	1914	2552	3190	5103
5000	606	808	1011	1617	5000	1989	2652	3315	5303
6000	648	864	1080	1728	6000	2126	2834	3543	5668
7000	686	914	1143	1828	7000	2249	2998	3748	5996
8000	720	960	1200	1919	8000	2361	3148	3935	6296
9000	751	1002	1252	2004	9000	2465	3286	4108	6572
10000	781	1041	1301	2082	10000	2561	3415	4269	6830
11000	809	1078	1348	2156	11000	2652	3536	4420	7072
12000	835	1113	1391	2226	12000	2738	3650	4563	7300
13000	859	1146	1432	2292	13000	2819	3758	4698	7517
14000	883	1177	1472	2354	14000	2896	3861	4827	7723
15000	905	1207	1509	2415	15000	2970	3960	4950	7920
20000	1006	1341	1676	2682	20000	3299	4398	5498	8796
25000	1091	1455	1818	2909	25000	3579	4771	5964	9543
30000	1166	1555	1944	3110	30000	3825	5100	6375	10200
40000	1295	1727	2159	3454	40000	4248	5664	7080	11329
50000	1405	1873	2342	3747	50000	4609	6145	7681	12290

* Swine operation housing hogs from about 23 kg (50 lbs) to market.

Appendix D-7B: Recommended MDS for Swine - Feeders (liquid manure)*

No. of Feeders	Minimum Distance Separation (metres)				No. of Feeders	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
100	163	218	272	436	100	536	714	893	1429
500	294	392	490	784	500	964	1285	1607	2571
600	314	419	524	838	600	1030	1374	1717	2747
750	341	454	568	909	750	1118	1490	1863	2981
1000	379	505	631	1009	1000	1241	1655	2069	3311
1200	405	539	674	1079	1200	1327	1769	2212	3538
1500	439	585	731	1170	1500	1440	1919	2399	3839
2000	487	650	812	1300	2000	1599	2132	2665	4264
2500	529	705	881	1410	2500	1735	2313	2891	4625
3000	565	754	942	1507	3000	1854	2472	3090	4944
3500	598	797	997	1594	3500	1961	2615	3269	5230
4000	628	837	1046	1674	4000	2059	2746	3432	5491
4500	655	874	1092	1748	4500	2150	2866	3583	5732
5000	681	908	1135	1816	5000	2234	2979	3723	5957
6000	728	971	1213	1941	6000	2388	3184	3979	6367
7000	770	1027	1283	2054	7000	2526	3368	4210	6736
8000	809	1078	1348	2158	8000	2652	3536	4420	7072
9000	844	1125	1407	2251	9000	2768	3691	4614	7383
10000	877	1170	1462	2339	10000	2877	3836	4795	7672
11000	908	1211	1514	2422	11000	2979	3972	4965	7944
12000	937	1250	1562	2500	12000	3075	4100	5125	8200
13000	965	1287	1609	2574	13000	3166	4222	5277	8443
14000	992	1322	1653	2645	14000	3253	4337	5422	8675
15000	1017	1356	1695	2712	15000	3336	4448	5560	8896
20000	1130	1506	1883	3012	20000	3705	4940	6175	9881
25000	1226	1634	2043	3268	25000	4020	5360	6699	10719
30000	1310	1746	2183	3493	30000	4296	5728	7160	11457
40000	1455	1940	2425	3880	40000	4772	6363	7953	12725
50000	1578	2104	2631	4209	50000	5177	6902	8628	13805

* Swine operation housing hogs from about 23 kg (50 lbs) to market.

Appendix D-8: Recommended MDS for Dairies - Free Stall (incl. dries)*

No. of Milking Cows	Minimum Distance Separation (metres)				No. of Milking Cows	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
30	162	216	271	433	30	533	710	888	1420
80	232	310	387	619	80	762	1016	1270	2032
100	252	336	420	672	100	826	1102	1377	2204
120	269	359	449	718	120	883	1178	1472	2356
140	285	380	475	760	140	934	1246	1557	2492
160	299	399	499	798	160	981	1308	1635	2616
180	312	416	520	833	180	1024	1366	1707	2731
200	325	433	541	865	200	1064	1419	1774	2838
225	339	452	565	903	225	1111	1482	1852	2963
250	352	469	587	939	250	1155	1540	1925	3079
275	365	486	608	972	275	1196	1594	1993	3188
300	376	502	627	1003	300	1234	1646	2057	3291
350	398	531	663	1061	350	1306	1741	2176	3482
400	418	557	697	1115	400	1371	1828	2285	3656
450	436	582	727	1163	450	1431	1908	2385	3816
500	453	605	756	1209	500	1487	1983	2479	3966
550	469	626	782	1252	550	1540	2053	2566	4106
600	485	646	808	1292	600	1590	2119	2649	4239
700	513	684	854	1367	700	1681	2242	2802	4484
800	538	718	897	1435	800	1765	2354	2942	4708
900	562	749	937	1498	900	1843	2457	3072	4915
1000	584	779	973	1557	1000	1915	2554	3192	5107
1500	677	903	1128	1806	1500	2221	2961	3701	5922
2000	752	1003	1253	2005	2000	2467	3289	4111	6578
2500	816	1088	1360	2176	2500	2676	3568	4460	7136
3000	872	1163	1453	2325	3000	2860	3813	4767	7627
4000	969	1291	1614	2583	4000	3177	4236	5295	8471
5000	1051	1401	1751	2802	5000	3446	4595	5744	9190

* Size based on lactating cows but includes all associated animals and replacement stock. Full year confinement.

Appendix D-9A: Recommended MDS for Poultry - Layers (solid manure)

No. of Birds	Minimum Distance Separation (metres)				No. of Birds	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
3000	150	197	247	395	3000	492	647	809	1295
5000	178	238	297	476	5000	585	780	975	1560
6000	191	254	318	508	6000	625	834	1042	1667
7000	202	269	336	538	7000	661	882	1102	1764
8000	212	282	353	565	8000	695	926	1158	1852
9000	221	295	368	589	9000	725	967	1208	1933
10000	230	306	383	613	10000	753	1005	1256	2009
12000	246	327	409	655	12000	805	1074	1342	2147
15000	266	355	444	710	15000	874	1165	1456	2330
20000	296	394	493	789	20000	970	1294	1617	2588
30000	343	457	572	915	30000	1125	1500	1875	3000
50000	413	551	689	1102	50000	1356	1808	2260	3615
75000	479	639	799	1278	75000	1572	2096	2620	4192
100000	532	710	887	1420	100000	1746	2328	2910	4656

Appendix D-9B: Recommended MDS for Poultry - Layers (liquid manure)

No. of Birds	Minimum Distance Separation (metres)				No. of Birds	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
2000	151	201	251	401	2000	494	658	823	1317
5000	210	280	351	561	5000	690	920	1150	1840
6000	225	300	375	600	6000	737	983	1229	1966
7000	238	317	396	634	7000	780	1040	1300	2080
8000	250	333	416	666	8000	819	1092	1365	2184
9000	261	348	434	695	9000	855	1140	1425	2280
10000	271	361	452	722	10000	889	1185	1481	2370
12000	290	386	483	772	12000	950	1266	1583	2533
15000	314	419	524	838	15000	1030	1374	1717	2747
20000	349	465	581	930	20000	1144	1526	1907	3052
30000	405	539	674	1079	30000	1327	1769	2212	3538
50000	487	650	812	1300	50000	1599	2132	2665	4264
75000	565	754	942	1507	75000	1854	2472	3090	4944
100000	628	837	1046	1674	100000	2059	2746	3432	5491

Appendix D-10: Recommended MDS for Poultry - Broilers (solid manure)

No. of Birds	Minimum Distance Separation (metres)				No. of Birds	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
10000	150	150	179	287	10000	492	492	588	941
15000	150	166	208	332	15000	492	545	682	1091
20000	150	185	231	369	20000	492	606	757	1211
25000	150	200	250	401	25000	493	657	821	1314
30000	161	214	268	428	30000	527	702	878	1405
35000	170	226	283	453	35000	557	743	929	1486
40000	178	238	297	476	40000	585	780	975	1560
50000	193	258	322	516	50000	635	846	1058	1692
75000	224	299	374	598	75000	736	981	1226	1962
100000	249	332	415	665	100000	817	1090	1362	2180
250000	348	464	580	928	250000	1142	1523	1903	3045
500000	448	598	747	1196	500000	1471	1961	2451	3922
750000	520	693	867	1386	750000	1705	2274	2842	4548
1000000	577	770	962	1540	1000000	1894	2526	3157	5051

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units

This table is useful in determining MDS for livestock operations of mixed species, unique types of livestock, and expansions.

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
20	150	164	205	329	20	492	539	674	1078
30	150	190	238	381	30	492	625	781	1250
40	159	212	264	423	40	521	694	868	1388
50	172	230	287	459	50	565	753	941	1506
60	184	245	307	491	60	604	805	1006	1610
70	195	259	324	519	70	639	851	1064	1703
80	204	272	341	545	80	670	894	1117	1788
90	213	284	356	569	90	700	933	1166	1866
100	222	296	369	591	100	727	970	1212	1940
110	230	306	383	612	110	753	1004	1255	2008
120	237	316	395	632	120	777	1036	1296	2073
130	244	325	407	651	130	800	1067	1334	2134
140	251	334	418	668	140	822	1096	1371	2193
150	257	343	428	685	150	843	1124	1406	2249
160	263	351	439	702	160	863	1151	1439	2302
170	269	359	448	717	170	883	1177	1471	2354
180	275	366	458	733	180	901	1202	1502	2404
190	280	374	467	747	190	919	1226	1532	2452
200	286	381	476	761	200	937	1249	1561	2498
210	291	388	484	775	210	954	1271	1589	2543
220	296	394	493	788	220	970	1293	1616	2586
230	300	401	501	801	230	986	1314	1643	2629
240	305	407	509	814	240	1001	1335	1669	2670
250	310	413	516	826	250	1016	1355	1694	2710
260	314	419	524	838	260	1031	1374	1718	2749
270	319	425	531	849	270	1045	1394	1742	2787
280	323	430	538	861	280	1059	1412	1765	2824
290	327	436	545	872	290	1073	1430	1788	2861
300	331	441	552	883	300	1086	1448	1810	2896
310	335	447	558	893	310	1099	1466	1832	2931
320	339	452	565	904	320	1112	1483	1853	2965
330	343	457	571	914	330	1125	1499	1874	2999

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units (contd.)

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
340	347	462	578	924	340	1137	1516	1895	3032
350	350	467	584	934	350	1149	1532	1915	3064
360	354	472	590	944	360	1161	1548	1935	3096
370	357	477	596	953	370	1173	1563	1954	3127
380	361	481	601	962	380	1184	1579	1973	3157
390	364	486	607	972	390	1195	1594	1992	3187
400	368	490	613	981	400	1206	1608	2011	3217
410	371	495	618	989	410	1217	1623	2029	3246
420	374	499	624	998	420	1228	1637	2047	3275
430	378	503	629	1007	430	1239	1651	2064	3303
440	381	508	635	1015	440	1249	1665	2082	3331
450	384	512	640	1024	450	1259	1679	2099	3358
460	387	516	645	1032	460	1269	1693	2116	3385
470	390	520	650	1040	470	1279	1706	2132	3412
480	393	524	655	1048	480	1289	1719	2149	3438
490	396	528	660	1056	490	1299	1732	2165	3464
500	399	532	665	1064	500	1309	1745	2181	3490
520	405	540	674	1079	520	1328	1770	2213	3540
540	410	547	684	1094	540	1346	1795	2243	3589
560	416	554	693	1109	560	1364	1819	2273	3637
580	421	561	702	1123	580	1382	1842	2303	3684
600	426	568	711	1137	600	1399	1865	2331	3730
620	431	575	719	1151	620	1416	1887	2359	3775
640	437	582	728	1164	640	1432	1909	2387	3819
660	441	589	736	1177	660	1448	1931	2414	3862
680	446	595	744	1190	680	1464	1952	2440	3904
700	451	601	752	1203	700	1480	1973	2466	3946
720	456	608	759	1215	720	1495	1993	2492	3987
740	460	614	767	1227	740	1510	2013	2517	4027
760	465	620	775	1239	760	1525	2033	2541	4066
780	469	626	782	1251	780	1539	2052	2566	4105
800	474	631	789	1263	800	1554	2072	2589	4143
820	478	637	796	1274	820	1568	2090	2613	4181

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units (contd.)

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
840	482	643	803	1285	840	1582	2109	2636	4217
860	486	648	810	1297	860	1595	2127	2659	4254
880	490	654	817	1307	880	1609	2145	2681	4290
900	494	659	824	1318	900	1622	2163	2703	4325
920	498	664	831	1329	920	1635	2180	2725	4360
940	502	670	837	1339	940	1648	2197	2746	4394
960	506	675	844	1350	960	1661	2214	2768	4428
980	510	680	850	1360	980	1673	2231	2788	4462
1000	514	685	856	1370	1000	1685	2247	2809	4495
1025	518	691	864	1382	1025	1701	2268	2835	4535
1050	523	697	872	1395	1050	1716	2288	2860	4575
1075	527	703	879	1407	1075	1731	2307	2884	4615
1100	532	709	887	1418	1100	1745	2327	2909	4654
1125	536	715	894	1430	1125	1760	2346	2933	4692
1150	541	721	901	1442	1150	1774	2365	2956	4730
1175	545	727	908	1453	1175	1788	2384	2979	4767
1200	549	732	915	1464	1200	1801	2402	3002	4804
1250	557	743	929	1486	1250	1828	2438	3047	4876
1300	565	754	942	1508	1300	1855	2473	3091	4946
1350	573	764	955	1529	1350	1881	2507	3134	5015
1400	581	774	968	1549	1400	1906	2541	3176	5082
1450	588	784	981	1569	1450	1930	2574	3217	5147
1500	596	794	993	1588	1500	1954	2606	3257	5212
1550	603	804	1005	1608	1550	1978	2637	3296	5274
1600	610	813	1016	1626	1600	2001	2668	3335	5336
1650	617	822	1028	1645	1650	2023	2698	3372	5396
1700	624	831	1039	1663	1700	2046	2728	3409	5455
1750	630	840	1050	1680	1750	2067	2757	3446	5513
1800	637	849	1061	1698	1800	2089	2785	3481	5570
1850	643	857	1072	1715	1850	2110	2813	3516	5626
1900	649	866	1082	1732	1900	2130	2841	3551	5681
1950	656	874	1093	1748	1950	2151	2868	3585	5735
2000	662	882	1103	1764	2000	2171	2894	3618	5788

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units (contd.)

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
2050	668	890	1113	1780	2050	2190	2920	3651	5841
2100	674	898	1123	1796	2100	2210	2946	3683	5893
2150	679	906	1132	1812	2150	2229	2972	3715	5943
2200	685	913	1142	1827	2200	2248	2997	3746	5993
2250	691	921	1151	1842	2250	2266	3021	3777	6043
2300	696	928	1160	1857	2300	2284	3046	3807	6091
2350	702	936	1170	1871	2350	2302	3070	3837	6139
2400	707	943	1179	1886	2400	2320	3093	3867	6187
2450	712	950	1187	1900	2450	2338	3117	3896	6234
2500	718	957	1196	1914	2500	2355	3140	3925	6280
2550	723	964	1205	1928	2550	2372	3163	3953	6325
2600	728	971	1214	1942	2600	2389	3185	3981	6370
2650	733	978	1222	1955	2650	2406	3207	4009	6415
2700	738	984	1230	1969	2700	2422	3229	4037	6459
2750	743	991	1239	1982	2750	2438	3251	4064	6502
2800	748	997	1247	1995	2800	2454	3272	4091	6545
2850	753	1004	1255	2008	2850	2470	3294	4117	6587
2900	758	1010	1263	2021	2900	2486	3315	4143	6629
2950	762	1017	1271	2033	2950	2502	3335	4169	6671
3000	767	1023	1279	2046	3000	2517	3356	4195	6712
3100	776	1035	1294	2070	3100	2547	3396	4245	6793
3200	785	1047	1309	2095	3200	2577	3436	4295	6872
3300	794	1059	1324	2118	3300	2606	3475	4343	6949
3400	803	1071	1338	2141	3400	2635	3513	4391	7026
3500	812	1082	1353	2164	3500	2663	3550	4438	7100
3600	820	1093	1367	2187	3600	2690	3587	4484	7174
3700	828	1104	1380	2209	3700	2717	3623	4529	7246
3800	836	1115	1394	2230	3800	2744	3658	4573	7317
3900	844	1126	1407	2251	3900	2770	3693	4616	7386
4000	852	1136	1420	2272	4000	2796	3727	4659	7455
4100	860	1146	1433	2293	4100	2821	3761	4701	7522
4200	867	1157	1446	2313	4200	2846	3794	4743	7589
4300	875	1167	1458	2333	4300	2870	3827	4784	7654

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units (contd.)

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
4400	882	1176	1470	2353	4400	2895	3859	4824	7719
4500	890	1186	1483	2372	4500	2918	3891	4864	7782
4600	897	1196	1494	2391	4600	2942	3923	4903	7845
4700	904	1205	1506	2410	4700	2965	3953	4942	7907
4800	911	1214	1518	2429	4800	2988	3984	4980	7968
4900	918	1223	1529	2447	4900	3011	4014	5018	8028
5000	924	1233	1541	2465	5000	3033	4044	5055	8087
5200	938	1250	1563	2501	5200	3077	4102	5128	8204
5400	951	1268	1585	2535	5400	3119	4159	5199	8318
5600	963	1285	1606	2569	5600	3161	4215	5268	8429
5800	976	1301	1626	2602	5800	3202	4269	5336	8538
6000	988	1317	1647	2635	6000	3242	4322	5403	8644
6200	1000	1333	1667	2666	6200	3281	4374	5468	8748
6400	1012	1349	1686	2697	6400	3319	4425	5531	8850
6600	1023	1364	1705	2728	6600	3356	4475	5594	8950
6800	1034	1379	1724	2758	6800	3393	4524	5655	9048
7000	1045	1394	1742	2787	7000	3429	4572	5715	9144
7200	1056	1408	1760	2816	7200	3465	4619	5774	9239
7400	1067	1422	1778	2844	7400	3499	4666	5832	9332
7600	1077	1436	1795	2872	7600	3534	4711	5889	9423
7800	1087	1450	1812	2899	7800	3567	4756	5945	9513
8000	1097	1463	1829	2926	8000	3600	4801	6001	9601
8200	1107	1476	1846	2953	8200	3633	4844	6055	9688
8400	1117	1489	1862	2979	8400	3665	4887	6108	9774
8600	1127	1502	1878	3005	8600	3697	4929	6161	9858
8800	1136	1515	1894	3030	8800	3728	4970	6213	9941
9000	1146	1527	1909	3055	9000	3759	5011	6264	10023
9200	1155	1540	1925	3080	9200	3789	5052	6315	10104
9400	1164	1552	1940	3104	9400	3819	5092	6364	10183
9600	1173	1564	1955	3128	9600	3848	5131	6414	10262
9800	1182	1576	1970	3151	9800	3877	5170	6462	10339
10000	1191	1587	1984	3175	10000	3906	5208	6510	10416
10500	1212	1616	2020	3232	10500	3976	5301	6627	10603

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units (contd.)

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
11000	1233	1644	2054	3287	11000	4044	5392	6740	10784
11500	1253	1670	2088	3341	11500	4110	5480	6851	10961
12000	1272	1697	2121	3393	12000	4175	5566	6958	11132
12500	1292	1722	2153	3444	12500	4237	5650	7062	11300
13000	1310	1747	2184	3494	13000	4298	5731	7164	11462
13500	1328	1771	2214	3542	13500	4358	5811	7263	11621
14000	1346	1795	2243	3590	14000	4416	5888	7360	11777
14500	1363	1818	2272	3636	14500	4473	5964	7455	11929
15000	1380	1841	2301	3681	15000	4529	6039	7548	12077
15500	1397	1863	2328	3725	15500	4583	6111	7639	12223
16000	1413	1884	2356	3769	16000	4637	6182	7728	12365
16500	1429	1906	2382	3811	16500	4689	6252	7815	12505
17000	1445	1927	2408	3853	17000	4741	6321	7901	12642
17500	1460	1947	2434	3894	17500	4791	6388	7985	12776
18000	1475	1967	2459	3934	18000	4841	6454	8068	12908
18500	1490	1987	2484	3974	18500	4889	6519	8149	13038
19000	1505	2006	2508	4013	19000	4937	6583	8228	13165
19500	1519	2026	2532	4051	19500	4984	6645	8307	13291
20000	1533	2044	2555	4089	20000	5030	6707	8384	13414
20500	1547	2063	2579	4126	20500	5076	6768	8460	13536
21000	1561	2081	2601	4162	21000	5121	6828	8535	13655
21500	1574	2099	2624	4198	21500	5165	6887	8608	13773
22000	1588	2117	2646	4233	22000	5208	6945	8681	13889
22500	1601	2134	2668	4268	22500	5251	7002	8752	14004
23000	1613	2151	2689	4303	23000	5294	7058	8823	14116
23500	1626	2168	2710	4337	23500	5335	7114	8892	14228
24000	1639	2185	2731	4370	24000	5376	7169	8961	14337
24500	1651	2202	2752	4403	24500	5417	7223	9029	14446
25000	1663	2218	2772	4436	25000	5457	7276	9095	14553
25500	1675	2234	2792	4468	25500	5497	7329	9161	14658
26000	1687	2250	2812	4500	26000	5536	7381	9226	14762
26500	1699	2265	2832	4531	26500	5575	7433	9291	14865
27000	1711	2281	2851	4562	27000	5613	7484	9354	14967

Appendix D-11: MDS Table for Livestock Facility Developments Based on Livestock Siting Units (contd.)

No. of LSUs	Minimum Distance Separation (metres)				No. of LSUs	Minimum Distance Separation (feet)			
	Category 1	Category 2	Category 3	Category 4		Category 1	Category 2	Category 3	Category 4
27500	1722	2296	2870	4593	27500	5650	7534	9417	15068
28000	1734	2311	2889	4623	28000	5688	7584	9479	15167
28500	1745	2326	2908	4653	28500	5725	7633	9541	15265
29000	1756	2341	2927	4683	29000	5761	7681	9602	15363
29500	1767	2356	2945	4712	29500	5797	7729	9662	15459
30000	1778	2370	2963	4741	30000	5833	7777	9721	15554
31000	1799	2399	2999	4798	31000	5903	7871	9838	15741
32000	1820	2427	3034	4854	32000	5972	7962	9953	15925
33000	1841	2454	3068	4909	33000	6039	8052	10065	16105
34000	1861	2481	3102	4962	34000	6105	8140	10176	16281
35000	1881	2508	3135	5015	35000	6170	8227	10284	16454
36000	1900	2534	3167	5067	36000	6234	8312	10390	16624
37000	1919	2559	3199	5118	37000	6297	8396	10495	16791
38000	1938	2584	3230	5168	38000	6358	8478	10597	16956
39000	1956	2609	3261	5217	39000	6419	8559	10698	17117
40000	1975	2633	3291	5266	40000	6478	8638	10797	17276
41000	1993	2657	3321	5313	41000	6537	8716	10895	17432
42000	2010	2680	3350	5360	42000	6595	8793	10991	17586
43000	2027	2703	3379	5407	43000	6652	8869	11086	17738
44000	2045	2726	3408	5452	44000	6708	8944	11180	17888
45000	2061	2749	3436	5497	45000	6763	9017	11272	18035
46000	2078	2771	3463	5541	46000	6818	9090	11363	18180
47000	2094	2792	3491	5585	47000	6871	9162	11452	18323
48000	2111	2814	3518	5628	48000	6924	9232	11540	18465
49000	2126	2835	3544	5671	49000	6977	9302	11628	18604
50000	2142	2856	3570	5713	50000	7028	9371	11714	18742
55000	2218	2957	3697	5915	55000	7277	9703	12128	19405
60000	2290	3053	3816	6106	60000	7512	10016	12520	20032
65000	2357	3143	3929	6287	65000	7735	10313	12891	20625
70000	2422	3230	4037	6459	70000	7947	10595	13244	21191
80000	2543	3391	4239	6782	80000	8344	11125	13906	22249
90000	2655	3540	4425	7080	90000	8710	11613	14517	23227
100000	2759	3679	4598	7357	100000	9052	12069	15086	24137

Appendix E

Land Base Guidelines for Livestock Operations

Explanation of Appendix E:

- These land base guidelines are intended for use at the environmental screening stage of planning.
- They **are not** to be used to determine recommended application rates on specific farms.
- These tables are based on average soil fertility levels in the four soil zones and manure nutrient from typical production systems. They do not allow for soil fertility and texture variability within soil zones, variations in manure nutrients, specialized crop types, and/or rotations.
- Due to these variations, the land base recommendations below may not be suitable for specific sites.
- The tables are the recommended land base where manure application is made on a yearly basis in conjunction with regular monitoring of soil nutrients.
- The land base recommendations are determined by the nitrogen requirements of the crop less it's carryover from previous applications. The assumed supply of nutrients from manure are listed in the table below.
- Manure utilization in sensitive watersheds and/or where erosion or runoff potential is high should also consider phosphorus in determining an adequate land base.
- These land based manure application rates do not take into account other fertilizer nutrients which may be used.

Assumed Crop Nutrient Requirements for Determining Land Base Guidelines

	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
Nutrient	kg/hectare	lbs/acre	kg/hectare	lbs/acre	kg/hectare	lbs/acre	kg/hectare	lbs/acre
Nitrogen	56	50	67	60	90	80	112	100
Phosphate	28	25	34	30	45	40	50	45
Potash	11	10	17	15	17	15	17	15

Appendix E-1: Land Base Requirements for Beef Feeders - Open Earthen Feedlots (solid manure)

No. of Feeders	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
300	24	59	20	50	15	37	12	30
400	32	79	27	66	20	50	16	40
500	40	99	33	83	25	62	20	50
600	48	119	40	99	30	74	24	59
700	56	139	47	116	35	87	28	69
800	64	158	53	132	40	99	32	79
900	72	178	60	149	45	111	36	89
1000	80	198	67	165	50	124	40	99
1200	96	238	80	198	60	149	48	119
1400	112	277	93	231	70	173	56	139
1600	128	317	107	264	80	198	64	158
1800	144	356	120	297	90	223	72	178
2000	160	396	134	330	100	248	80	198
2500	200	495	167	413	125	309	100	248
3000	240	594	200	495	150	371	120	297
3500	280	693	234	578	175	433	140	347
4000	321	792	267	660	200	495	160	396
5000	401	990	334	825	250	619	200	495
6000	481	1188	401	990	301	743	240	594
7000	561	1386	467	1155	351	866	280	693
8000	641	1584	534	1320	401	990	321	792
9000	721	1782	601	1485	451	1114	361	891
10000	801	1980	668	1650	501	1238	401	990
12000	962	2376	801	1980	601	1485	481	1188
14000	1122	2772	935	2310	701	1733	561	1386
16000	1282	3168	1069	2640	801	1980	641	1584
18000	1443	3564	1202	2970	902	2228	721	1782
20000	1603	3960	1336	3300	1002	2475	801	1980
25000	2003	4951	1670	4125	1252	3094	1002	2475
30000	2404	5941	2003	4951	1503	3713	1202	2970
40000	3206	7921	2671	6601	2003	4951	1603	3960
50000	4007	9901	3339	8251	2504	6188	2003	4951

Appendix E-2: Land Base Requirements for Beef Finishers - Open Earthen Feedlots (solid manure)

No. of Finishers	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
300	37	93	31	77	23	58	19	46
400	50	123	42	103	31	77	25	62
500	62	154	52	129	39	96	31	77
600	75	185	62	154	47	116	37	93
700	87	216	73	180	55	135	44	108
800	100	247	83	206	62	154	50	123
900	112	278	94	231	70	174	56	139
1000	125	309	104	257	78	193	62	154
1200	150	370	125	309	94	231	75	185
1400	175	432	146	360	109	270	87	216
1600	200	494	166	411	125	309	100	247
1800	225	555	187	463	140	347	112	278
2000	250	617	208	514	156	386	125	309
2500	312	771	260	643	195	482	156	386
3000	375	926	312	771	234	579	187	463
3500	437	1080	364	900	273	675	219	540
4000	499	1234	416	1028	312	771	250	617
5000	624	1543	520	1286	390	964	312	771
6000	749	1851	624	1543	468	1157	375	926
7000	874	2160	728	1800	546	1350	437	1080
8000	999	2468	832	2057	624	1543	499	1234
9000	1124	2777	937	2314	702	1736	562	1388
10000	1249	3085	1041	2571	780	1928	624	1543
12000	1498	3703	1249	3085	937	2314	749	1851
14000	1748	4320	1457	3600	1093	2700	874	2160
16000	1998	4937	1665	4114	1249	3085	999	2468
18000	2248	5554	1873	4628	1405	3471	1124	2777
20000	2497	6171	2081	5142	1561	3857	1249	3085
25000	3122	7714	2601	6428	1951	4821	1561	3857
30000	3746	9256	3122	7714	2341	5785	1873	4628
40000	4995	12342	4162	10285	3122	7714	2497	6171
50000	6243	15427	5203	12856	3902	9642	3122	7714

Appendix E-3: Land Base Requirements for Swine - Farrow to Finish (liquid manure)

No. of Sows	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
50	33	83	28	69	21	52	17	41
100	67	165	56	138	42	103	33	83
125	84	206	70	172	52	129	42	103
150	100	248	84	206	63	155	50	124
175	117	289	97	241	73	181	58	144
200	134	330	111	275	84	206	67	165
250	167	413	139	344	104	258	84	206
300	200	495	167	413	125	310	100	248
350	234	578	195	482	146	361	117	289
400	267	660	223	550	167	413	134	330
500	334	825	278	688	209	516	167	413
600	401	991	334	825	251	619	200	495
750	501	1238	418	1032	313	774	251	619
1000	668	1651	557	1376	418	1032	334	825
1500	1002	2476	835	2064	626	1548	501	1238
2000	1336	3302	1114	2752	835	2064	668	1651
2500	1670	4127	1392	3439	1044	2580	835	2064
3000	2004	4953	1670	4127	1253	3095	1002	2476
3500	2338	5778	1949	4815	1462	3611	1169	2889
4000	2672	6604	2227	5503	1670	4127	1336	3302
5000	3341	8255	2784	6879	2088	5159	1670	4127
10000	6681	16509	5568	13758	4176	10318	3341	8255
15000	10022	24764	8352	20636	6264	15477	5011	12382
20000	13362	33018	11135	27515	8352	20636	6681	16509

Appendix E-4: Land Base Requirements for Swine - Farrowing (liquid manure)

No. of Sows	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
50	8	20	7	17	5	13	4	10
100	16	40	14	33	10	25	8	20
125	20	50	17	42	13	31	10	25
150	24	60	20	50	15	38	12	30
175	28	70	24	58	18	44	14	35
200	32	80	27	67	20	50	16	40
250	41	100	34	84	25	63	20	50
300	49	120	41	100	30	75	24	60
350	57	140	47	117	35	88	28	70
400	65	160	54	134	41	100	32	80
500	81	200	68	167	51	125	41	100
600	97	241	81	200	61	150	49	120
750	122	301	101	251	76	188	61	150
1000	162	401	135	334	101	251	81	200
1500	243	601	203	501	152	376	122	301
2000	325	802	270	668	203	501	162	401
2500	406	1002	338	835	254	627	203	501
3000	487	1203	406	1002	304	752	243	601
3500	568	1403	473	1170	355	877	284	702
4000	649	1604	541	1337	406	1002	325	802
5000	811	2005	676	1671	507	1253	406	1002
8000	1298	3208	1082	2673	811	2005	649	1604
10000	1623	4010	1352	3341	1014	2506	811	2005
15000	2434	6015	2028	5012	1521	3759	1217	3007
20000	3246	8020	2705	6683	2028	5012	1623	4010

Appendix E-5: Land Base Requirements for Swine - Farrow to Wean (liquid manure)

No. of Sows	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
50	10	25	9	21	6	16	5	13
100	21	51	17	42	13	32	10	25
125	26	63	21	53	16	40	13	32
150	31	76	26	63	19	48	15	38
175	36	89	30	74	22	56	18	44
200	41	101	34	85	26	63	21	51
250	51	127	43	106	32	79	26	63
300	62	152	51	127	39	95	31	76
350	72	178	60	148	45	111	36	89
400	82	203	68	169	51	127	41	101
500	103	254	86	211	64	159	51	127
600	123	304	103	254	77	190	62	152
750	154	381	128	317	96	238	77	190
1000	205	507	171	423	128	317	103	254
1500	308	761	257	634	193	476	154	381
2000	411	1015	342	846	257	634	205	507
2500	513	1269	428	1057	321	793	257	634
3000	616	1522	513	1269	385	952	308	761
3500	719	1776	599	1480	449	1110	359	888
4000	822	2030	685	1692	513	1269	411	1015
5000	1027	2537	856	2115	642	1586	513	1269
8000	1643	4060	1369	3383	1027	2537	822	2030
10000	2054	5075	1712	4229	1284	3172	1027	2537
15000	3081	7612	2567	6344	1925	4758	1540	3806
20000	4108	10150	3423	8458	2567	6344	2054	5075

Appendix E-6: Land Base Requirements for Swine - Weaners (liquid manure)

No. of Weaners	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
500	11	28	10	23	7	18	6	14
600	14	34	11	28	9	21	7	17
700	16	39	13	33	10	25	8	20
800	18	45	15	38	11	28	9	23
900	21	51	17	42	13	32	10	25
1000	23	56	19	47	14	35	11	28
1500	34	85	29	70	21	53	17	42
2000	46	113	38	94	29	70	23	56
2500	57	141	48	117	36	88	29	70
3000	68	169	57	141	43	106	34	85
4000	91	226	76	188	57	141	46	113
5000	114	282	95	235	71	176	57	141
6000	137	338	114	282	86	211	68	169
7000	160	395	133	329	100	247	80	197
8000	183	451	152	376	114	282	91	226
9000	205	507	171	423	128	317	103	254
10000	228	564	190	470	143	352	114	282
15000	342	846	285	705	214	529	171	423
20000	456	1128	380	940	285	705	228	564
25000	571	1410	475	1175	357	881	285	705
30000	685	1692	571	1410	428	1057	342	846
40000	913	2256	761	1880	571	1410	456	1128
50000	1141	2819	951	2349	713	1762	571	1410

Appendix E-7: Land Base Requirements for Swine - Feeders (liquid manure)

No. of Feeders	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
100	7	18	6	15	5	11	4	9
500	36	89	30	74	23	56	18	45
600	43	107	36	89	27	67	22	54
750	54	134	45	112	34	84	27	67
1000	72	179	60	149	45	112	36	89
1200	87	214	72	179	54	134	43	107
1500	108	268	90	223	68	167	54	134
2000	145	357	120	298	90	223	72	179
3000	217	536	181	446	135	335	108	268
3500	253	625	211	521	158	391	126	312
4000	289	714	241	595	181	446	145	357
4500	325	804	271	670	203	502	163	402
5000	361	893	301	744	226	558	181	446
6000	434	1071	361	893	271	670	217	536
7000	506	1250	422	1042	316	781	253	625
8000	578	1428	482	1190	361	893	289	714
9000	650	1607	542	1339	406	1004	325	804
10000	723	1786	602	1488	452	1116	361	893
11000	795	1964	662	1637	497	1228	397	982
12000	867	2143	723	1786	542	1339	434	1071
13000	939	2321	783	1934	587	1451	470	1161
14000	1012	2500	843	2083	632	1562	506	1250
15000	1084	2678	903	2232	677	1674	542	1339
20000	1445	3571	1204	2976	903	2232	723	1786
25000	1807	4464	1505	3720	1129	2790	903	2232
30000	2168	5357	1807	4464	1355	3348	1084	2678
40000	2891	7142	2409	5952	1807	4464	1445	3571
50000	3613	8928	3011	7440	2258	5580	1807	4464

Appendix E-8: Land Base Requirements for Dairies - Free Stall (liquid manure)

No. of Milking Cows	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
30	28	69	23	57	17	43	14	34
80	74	183	62	153	46	115	37	92
100	93	229	77	191	58	143	46	115
120	111	275	93	229	70	172	56	137
140	130	321	108	267	81	200	65	160
160	148	367	124	306	93	229	74	183
180	167	412	139	344	104	258	83	206
200	185	458	155	382	116	286	93	229
225	209	516	174	430	130	322	104	258
250	232	573	193	477	145	358	116	286
275	255	630	213	525	159	394	128	315
300	278	687	232	573	174	430	139	344
350	325	802	270	668	203	501	162	401
400	371	917	309	764	232	573	185	458
450	417	1031	348	859	261	644	209	516
500	464	1146	386	955	290	716	232	573
550	510	1260	425	1050	319	788	255	630
600	556	1375	464	1146	348	859	278	687
700	649	1604	541	1337	406	1002	325	802
800	742	1833	618	1528	464	1146	371	917
900	835	2062	695	1719	522	1289	417	1031
1000	927	2291	773	1909	580	1432	464	1146
1500	1391	3437	1159	2864	869	2148	695	1719
2000	1855	4583	1546	3819	1159	2864	927	2291
2500	2318	5728	1932	4774	1449	3580	1159	2864
3000	2782	6874	2318	5728	1739	4296	1391	3437
4000	3709	9165	3091	7638	2318	5728	1855	4583
5000	4637	11457	3864	9547	2898	7160	2318	5728

Appendix E-9: Land Base Requirements for Poultry - Layers (solid manure)

No. of Layers	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
3000	17	41	14	34	10	26	8	20
5000	28	68	23	57	17	43	14	34
6000	33	82	28	68	21	51	17	41
7000	39	95	32	79	24	60	19	48
8000	44	109	37	91	28	68	22	54
9000	50	122	41	102	31	77	25	61
10000	55	136	46	113	34	85	28	68
12000	66	163	55	136	41	102	33	82
15000	83	204	69	170	52	128	41	102
20000	110	272	92	227	69	170	55	136
30000	165	408	138	340	103	255	83	204
50000	275	681	230	567	172	425	138	340
750000	413	1021	344	851	258	638	207	510
1000000	551	1361	459	1134	344	851	275	681

Appendix E-10: Land Base Requirements for Poultry - Broilers (solid manure)

No. of Broilers	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
10000	33	80	27	67	20	50	16	40
15000	49	120	41	100	30	75	24	60
20000	65	161	54	134	41	100	33	80
25000	81	201	68	167	51	126	41	100
30000	98	241	81	201	61	151	49	120
35000	114	281	95	234	71	176	57	141
40000	130	321	108	268	81	201	65	161
50000	163	402	135	335	102	251	81	201
75000	244	602	203	502	152	377	122	301
100000	325	803	271	669	203	502	163	402
250000	813	2008	677	1673	508	1255	406	1004
500000	1625	4016	1354	3347	1016	2510	813	2008
750000	2438	6024	2032	5020	1524	3765	1219	3012
1000000	3251	8032	2709	6694	2032	5020	1625	4016

Appendix E-11: Land Base Requirements for Turkey - Broilers (solid manure)

No. of Turkeys	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
1000	5	13	4	11	3	8	3	7
1500	8	20	7	16	5	12	4	10
2000	11	26	9	22	7	16	5	13
3000	16	39	13	33	10	24	8	20
4000	21	52	18	43	13	33	11	26
5000	26	65	22	54	16	41	13	33
6000	32	78	26	65	20	49	16	39
7000	37	91	31	76	23	57	18	46
8000	42	104	35	87	26	65	21	52
9000	47	117	40	98	30	73	24	59
10000	53	130	44	109	33	81	26	65
15000	79	195	66	163	49	122	40	98
20000	105	261	88	217	66	163	53	130

Appendix E-12: Land Base Requirements for Sheep - Feeders (solid manure)

No. of Feeders	Soil Type							
	Dark Brown & Brown		Grey Wooded		Black		Irrigated	
	hectares	acres	hectares	acres	hectares	acres	hectares	acres
600	10	24	8	20	6	15	5	12
700	11	28	10	24	7	18	6	14
800	13	32	11	27	8	20	7	16
900	15	36	12	30	9	23	7	18
1000	16	40	14	34	10	25	8	20
2000	33	81	27	67	20	51	16	40
5000	82	202	68	169	51	126	41	101
10000	164	405	136	337	102	253	82	202

Appendix F

Estimating the Runoff Volume from Open Lots

Explanation of Appendix F:

The intent is to prevent runoff from leaving the property. Normal practice, based on the *Alberta Feedlot Management Guide - 2000*, is to utilize the runoff nutrients by applying them to cropland. Depending on the management of the feedlot, it may be necessary to store the runoff for a period of time until application is practical.

Precipitation data listed in **Appendix F-1** is from the *1997 Alberta Building Code* and is defined as:

One Day Rainfall (mm): A one day rainfall that has a 1 chance in 30 of being exceeded in any one year.

Snow Load/Water Equivalent (mm): The amount of water equivalent to the accumulated winter snowfall that has a 1 chance in 30 of being exceeded in any one year.

Annual Total Precipitation (mm): The average total rainfall and snowfall accumulations based on data from Alberta weather stations measured from 1961 to 1990.

Area of the Feedlot: The total drainage area, including pens, alleys and roadways.

Apply the following formulas for each of the situations listed below.

1. Designing to hold one day rainfall where runoff from the storage is immediately applied to cropland.

A 1 in 30 year, one day rain falls on a feedlot. An unpaved lot with a bedding pack has the capacity to store 25 to 30 mm of rain while a paved lot without a bedding pack has no capacity to store rainfall. Based on the amount of precipiation for the site closest to the feedlot (**Appendix F-1**), use the appropriate runoff coefficient from the table below.

One Day Rainfall (mm) 1 in 30 yr. probability	Runoff Coefficient (unpaved lot)	Runoff Coefficient (paved lot)
65 - 86	0.15	1.0
87 - 95	0.20	1.0
96 - 105	0.25	1.0

One Day Rainfall Runoff Volume = Area of the Feedlot x One Day Rain x Runoff Coefficient

2. Designing to store the spring snowmelt runoff from feedlots used in the winter, such as backgrounding lots.

Spring Snowmelt Runoff Volume = Area of the Feedlot x Snow Load/Water Equivalent x (0.20 - 0.35)*

3. Designing to store the annual accumulated rainfall and snowfall runoff.

Annual Runoff Volume = Area of Feedlot x Annual Total Precipitation x (0.20 - 0.50)*

* An assessment is required to determine the runoff coefficients for annual runoff and spring snowmelt runoff. The factors to consider are slope, bedding pack, pen cleaning schedule, and catch basin management.

Catch basin sizing: Include 450 mm of freeboard in addition to the calculated catch basin size as a safety factor. As well, consider the possibility of designing for a volume of two or more consecutive one day rainfalls.

Appendix F-1: Precipitation Data for Estimating Open Feedlot Runoff

Location	One Day Rainfall (mm) 1 in 30 year	Annual Total Precipitation (mm)	Snow Load/Water Equivalent (mm)
Acadia Valley	75	310	153
Airdrie	95	440	122
Athabasca	80	480	185
Banff	60	500	347
Barrhead	80	475	173
Bashaw	85	460	194
Bassano	85	340	133
Beaumont	90	475	184
Beaverlodge	85	470	234
Berwyn	80	395	224
Black Diamond	90	495	143
Blackfalds	95	475	204
Bon Accord	85	485	173
Bonnyville	75	430	184
Bow Island	80	340	143
Bowden	95	480	173
Brooks	80	340	122
Bruderheim	95	480	173
Calgary	95	425	112
Calmar	95	490	184
Campsie	80	475	173
Camrose	85	470	194
Canmore	65	500	336
Cardston	100	550	153
Carstairs	105	475	163
Castor	85	405	204
Claresholm	95	440	133
Coaldale	85	390	133
Cochrane	75	500	143
Cold Lake	75	430	173
Coleman	70	550	265
Coronation	85	400	214
Cowley	75	525	163

Appendix F-1: Precipitation Data for Estimating Open Feedlot Runoff (contd.)

Location	One Day Rainfall (mm) 1 in 30 year	Annual Total Precipitation (mm)	Snow Load/Water Equivalent (mm)
Crossfield	105	485	153
Daysland	85	455	184
Devon	90	490	184
Didsbury	100	480	153
Drayton Valley	85	525	194
Drumheller	80	375	153
Eckville	105	540	194
Edmonton	90	460	173
Edson	75	570	204
Elk Point	75	440	184
Embarras Portage	80	390	184
Fairview	80	450	255
Falher	55	420	234
Foremost	70	360	163
Fort Chipewyan	70	381	214
Fort Macleod	90	425	122
Fort McMurray	65	460	184
Fort Saskatchewan	80	425	163
Fort Vermilion	60	380	204
Fox Creek	90	550	214
Gibbons	85	485	173
Gliechen	90	360	133
Grand Center	75	435	184
Grande Cache	70	605	306
Grande Prairie	80	450	214
Granum	95	440	143
Grimshaw	80	390	224
Habay	65	425	234
Hanna	90	390	184
Hardisty	70	425	173
High Level	75	420	234
High Prairie	75	470	224
High River	95	425	133

Appendix F-1: Precipitation Data for Estimating Open Feedlot Runoff (contd.)

Location	One Day Rainfall (mm) 1 in 30 year	Annual Total Precipitation (mm)	Snow Load/Water Equivalent (mm)
Hinton	75	500	285
Innisfail	95	480	184
Irvine	75	360	143
Jasper	70	400	316
Keg River	60	450	234
Killam	90	445	184
Kitscoty	80	430	184
Lac La Biche	80	475	163
Lacombe	85	450	204
Lake Louise	55	580	428
Lamont	90	460	173
Leduc	90	485	184
Lethbridge	90	390	122
Lloydminster	70	430	194
Magrath	80	430	153
Manning	75	390	224
Mayerthorpe	90	555	194
McLennan	65	425	234
Medicine Hat	85	325	112
Milk River	70	375	163
Millet	95	475	184
Morinville	90	480	184
Morrin	75	390	173
Mundare	90	450	184
Nanton	95	440	133
Okotoks	95	470	143
Olds	95	485	173
Oyen	75	330	163
Peace River	60	390	214
Penhold	95	470	184
Picture Butte	85	400	122
Pincher Creek	100	575	153
Ponoka	80	480	194

Appendix F-1: Precipitation Data for Estimating Open Feedlot Runoff (contd.)

Location	One Day Rainfall (mm) 1 in 30 year	Annual Total Precipitation (mm)	Snow Load/Water Equivalent (mm)
Provost	80	415	184
Rainbow Lake	75	450	265
Ranfurly	85	420	184
Raymond	75	420	143
Red Deer	90	475	194
Redcliff	85	325	133
Redwater	80	470	173
Rimbey	100	505	214
Rocky Mountain House	80	550	184
Ryley	90	465	184
Sangudo	95	555	194
Sedgewick	95	440	184
Sexsmith	85	445	234
Sherwood Park	90	480	173
Slave Lake	75	500	214
Smoky Lake	75	480	184
Spirit River	75	440	234
Spruce Grove	90	500	173
Stavely	95	440	143
Stettler	90	450	214
Stony Plain	90	540	173
Strathmore	80	430	133
St. Albert	95	480	173
St. Paul	75	440	184
Suffield	80	325	133
Sundre	95	530	163
Swan Hills	95	500	275
Sylvan Lake	95	545	204
Taber	85	370	122
Thorhild	75	480	173
Three Hills	80	400	173
Tofield	95	465	184
Trochu	75	405	173

Appendix F-1: Precipitation Data for Estimating Open Feedlot Runoff (contd.)

Location	One Day Rainfall (mm) 1 in 30 year	Annual Total Precipitation (mm)	Snow Load/Water Equivalent (mm)
Turner Valley	90	600	143
Two Hills	80	450	184
Valleyview	80	490	224
Vauxhall	85	335	122
Vegreville	80	410	184
Vermilion	80	410	173
Viking	65	445	184
Vulcan	90	410	133
Wagner	70	500	214
Wainwright	75	425	194
Warner	75	375	153
Wembley	85	470	224
Westlock	75	490	184
Wetaskiwin	80	500	194
Whitecourt	90	550	184
Wimborne	85	450	163